A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

MAY, 1935.

GENERAL PHYSICS.

ADSORPTION.

1882. Theory of Adsorption. S. Miyamoto. *Kolloid Zeits.* 70. *pp.* 275–277, *March*, 1935.—An adsorption theory is proposed which depends upon the assumption that only those molecules can escape from the adsorbed layer whose vibration energies perpendicular to the boundary surface (or whose energy of translatory motion upon the surface) are greater than a limiting value ϵ_0; also, that of the molecules in the gas phase only those can condense on the solid surface, which strike the surface with velocities whose components perpendicular to the surface are greater than a limiting value u_0. Based on this theory the following equations are derived for adsorption velocity:

$$dx/dt = (1 - x/\mathrm{N}_0)^n\, \mathrm{N}pe^{-\mathrm{MU}_0^2/2\mathrm{RT}}/\sqrt{2\,\pi\mathrm{MRT}} - (x/\mathrm{N}_0)^n b\mathrm{N}_0 e^{-\mathrm{N}\epsilon_0/\mathrm{RT}}$$
$$\text{mol./ sq. cm. / sec.}$$

The amount of adsorbed material is given by $a = \mathrm{N}_0\mathrm{K}p^{1/n}/(1 + \mathrm{K}p^{1/n})$ mol./ sq. cm. When the amount of the latter is very small, the above equation becomes $a = \mathrm{N}_0\mathrm{K}p^{1/n}/\mathrm{N}$ mol./ sq. cm., and when the amount of adsorbed gas is very large, $a = \mathrm{N}_0(1 - 1\mathrm{K}/p^{1/n})/\mathrm{N}$, mol./ sq. cm.
H. H. Ho.

1883. Adsorption of Gases on Mercury. R. S. Burdon. *Phys. Soc. Proc.* 47. *pp.* 460–470, *May* 1, 1935.—A mercury surface was formed in the presence of a gas and the gas was pumped off after an interval. The mercury surface was then caused to collapse. This caused an evolution of gas which was measured with a McLeod gauge. For air, H_2 and CO_2 the limiting amount evolved corresponded to a monomolecular layer. This layer appeared to be retained by the surface for a long period. If adsorption beyond a monomolecular layer occurred the subsequent layers were desorbed on evacuation. AUTHOR.

1884. Sorption of Hydrogen by Reduced Nickel. Part IV. Velocity of Sorption in the Earlier Stages. S. Iijima. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 545. *pp.* 46–69, *Jan.*, 1935. *In English*.—The adsorption of hydrogen by reduced nickel has been studied at temperatures between − 78° and 100° C. over a period between 10 sec. and 90 min. after admission of the gas to the experimental vessel. The absorption time curves show in general three parts, each approximately linear, with sharp changes in slope; the indicated changes in sorption-velocity are interpreted as due to an early change over from initial van der Waals adsorption (due to molecular forces) to "activated" adsorption. [For Parts I–III see Abstract 861 (1934).] L. V. C.

✱1885. Sorption of Bromine and Iodine by Silica Gel. A. E. Cameron and L. H. Reyerson. *J. Phys. Chem.* 39. *pp.* 169–179, *Feb.*, 1935.—An apparatus combining the sorption balance of McBain and Bakr and a quartz spiral manometer is described. Using this apparatus the sorption of bromine by silica gel was measured at 58°, 79°, 99°, 117·5° and 137·7° C. Using similar technique the sorption of iodine was measured at 98·2°, 137·6°, 158·3°, 178·4°, and 198·5° C. [See following Abstract.] AUTHORS.

1886. Sorption of Halogens by Silica Gel and Charcoal. L. H. Reyerson and A. E. Cameron. *J. Phys. Chem.* 39. *pp.* 181–190, *Feb.*, 1935.—Sorptions of bromine and iodine on silica gel and activated charcoal have been measured in an all-glass-quartz system at widely different temperatures. Sorptions by silica gel indicate a loose physical binding or capillary condensation. Sorptions by charcoal indicate activated sorption that is monomolecular in depth of layer. [See preceding Abstract.] AUTHORS.

1887. Adsorption on Measured Surfaces of Vitreous Silica. W. G. Palmer and R. E. D. Clark. *Roy. Soc., Proc.* 149A. *pp.* 360–384, *April* 1, 1935.—A study has been made of the adsorption of vapours on powdered vitreous silica, prepared by a method that excludes fortuitous contamination of the surface. The absolute surface available for adsorption has been determined from measurements of the initial rate of dissolution of the powder in dilute HF. The areas covered by molecules on the surface have been calculated and found to agree with values from other sources. A general expression has been proposed connecting adsorption potential with amount absorbed, leading to a new theoretical isothermal. The restricted applicability of Langmuir's formula to parts of the isothermals is interpreted theoretically. Special experiments were made on the form of the adsorption isothermal at low adsorptions. AUTHORS.

1888. Kinetics of Sorption Processes of Hydrogen on Iron. N. M. Morozov. *Faraday Soc., Trans.* 31. *pp.* 659–668, *April*, 1935.—Three different types of sorption are shown to exist in the temperature range between − 190° and + 400° for the sorption of hydrogen by iron. They are: van der Waals adsorption, activated adsorption, and activated diffusion. In certain temperature ranges it is possible to separate these processes and investigate the kinetics of each individual process. A value of $E \sim 20{,}000$ Cal. has been obtained for the activation energy of activated adsorption (for 1·0 c.c. of amount of gas adsorbed) and a value of $E \sim 8{,}000$ Cal. for activated diffusion. In the temperature range from 300° to 400° the activated adsorption is an instantaneous and entirely reversible sorption process. Owing to this the true isotherms of activated adsorption could be obtained and from these the heat of adsorption has been calculated. Howard's results showing that the activated adsorption diminishes the van der Waals adsorption are confirmed. It is shown, however, that under certain experimental conditions the absence of such a relation between the two types of sorption is possible. AUTHOR.

1889. Theory of Electrical Double Layers in Adsorbed Films. R. W. Gurney. *Phys. Rev.* 47. *pp.* 479–482, *March* 15, 1935.—The nature of an absorbed layer is discussed in terms of quantum mechanics, and the factors governing the sign and magnitude of the electrical double-layer are determined. Although the ionisation potentials of Ca, Sr and Ba are greater than the electronic work function of tungsten, a sparse distribution of these atoms on a tungsten surface behaves in a way quite similar to atoms of alkali metals whose ionisation potentials are much smaller. This behaviour can be understood only in terms of quantum mechanics. AUTHOR.

See also Abstract 2246.

ATOMIC AND MOLECULAR STRUCTURE.

1890. Exchange of Constituent Particles Between Pairs of Nuclei. P. Pavinskij. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 93–96, *Jan.* 21, 1935. *In French.*—Such exchange can only occur when the nuclei collide, when they must be regarded as forming one dynamic system. This results in a change in the internal energy of each, a change evidenced by change in the energy of mutual attraction or repulsion. These forces of exchange and the Coulomb forces are calculated for a collision between two identical particles for the cases where the orbital moment, $l =$ and $\neq 0$. The result shows that the less the energy of binding of the constituent particles the greater is the diminution of energy resulting from the exchange. This may explain the ease of penetration of deutons in artificial transmutation. An approximate calculation gives the probability of mutual penetration in collisions Li^6–Li^6 as of the order of 0·01, and slightly less for Li^7–Li^7. [See Abstracts 1673 (1933) and 2258 (1934).] C. A. S.

1891. Empirical Limits of Stability of Atomic Nuclei. G. Racah. *Zeits. f. Physik*, 93. 9–10 *p.* 704, *Feb.* 14, 1935.—Reference is made to a paper by Gamow [see Abstract 3453 (1934)] in which curves of minimum energy are given for stable types of nuclei according to experimental data. These curves are represented as consisting of seven or eight turns. The present author points out that the existence of these turns may by no means be considered as certain in the light of our present knowledge and that some of them are certainly non-existent. Illustrations of the statement are given for Pt, Rb and Cs. H. L. B.

1892. Applicability of Principle of Conservation of Momentum to Nuclear Processes. J. Solomon. *Comptes Rendus*, 200. *pp.* 905–907, *March* 11, 1935.—The case is considered of collisions of protons with deutons or light elements, and the effective cross section for emission of radiation of given frequency is calculated [see Abstract 3400 (1932)]. For boron it is $0{\cdot}5 \times 10^{-31}$ cm^2. C. A. S.

1893. Energy Released in Nuclear Transformations. M. L. E. Oliphant, A. R. Kempton and (Lord) Rutherford. *Roy. Soc., Proc.* 149A. *pp.* 406–416, *April* 1, 1935.—Experiments have been made to determine accurately the ranges and energies of the swift particles emitted in certain transformations. It is found that when changes of mass are taken into account the law of conservation of energy holds closely for the transformations of the isotopes of lithium when bombarded by ions of ordinary and of heavy hydrogen. The masses of Li^6 and Li^7 are found to be 6·0143 ± 0·0002 and 7·0148 ± 0·0002 respectively, in good agreement with the mass spectroscopic values 6·0145 ± 0·0003 and 7·0146 ± 0·0006 found by Bainbridge. By application of the laws of conservation of momentum and energy the mass of the hydrogen isotope of mass 3 is found to be 3·0152 ± 0·0002. Attention is drawn to the factors involved in determining the mean ranges of expelled particles and to the difficulties of interpretation when more than two particles are emitted in a single transformation. Authors.

1894. Production of Radiation Comparable with Cosmic Rays. F. Joliot and L. Kowarski. *Comptes Rendus*, 200. *pp.* 824–827, *March* 4, 1935.—When Ag is bombarded with neutrons from Po + Be in a Wilson chamber with a vertical magnetic field of 1000 gauss, among the trajectories of electrons originating from the Ag, in addition to those due to secondaries of the photons (of energy 5×10^6 eV) emitted by Po + Be together with the neutrons, there are some (about 5 % of the whole) which indicate electrons of energy $20–30 \times 10^6$ eV, and which could only be due to primary radiation from the Ag. There was also some evidence of the simultaneous emission of some of these electrons in groups of two or three,

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in a similar manner to the "showers" produced by cosmic rays. With P and I similar effects were observed save that in their case they continued after removal of the source of neutrons. It would seem that Ag^{107} and Ag^{109} by capture of a neutron are transformed into radio-$Ag^{108\,\&\,110}$, which then disintegrate, giving rise to Cd^{108} and Cd^{110}, energy of about $(20 \pm 10) \times 10^6$ eV. being emitted, and similarly in the cases of P and I.
C. A. S.

1895. Radioactivity Produced by Neutrons. P. Preiswerk. *Comptes Rendus*, 200. *pp*. 827–829, *March* 4, 1935.—I_{Be} and I_B denoting the intensities of the radioactivity produced by neutrons from Rn + Be and Rn + B respectively, the ratio I_{Be}/I_B for substances showing the protonic effect, *e.g.*, Au (period 2·5 days), Ag (20 sec.), Th (1 min.), Mn (2·5 hr.), Ag (2 min.), I (30 min.), and Cu (6 min.) is 1–10, while for Si (2·5 min.), Al (12 min.) and Fe (2·5 hr.), which do not show the effect, $I_B = 0$. From this it is concluded that only rapid neutrons, of energy $> 5{\cdot}9 \times 10^6$ eV, are effective in these cases. The fact that Mg (40 sec.), though insensitive to the effect, gives a ratio 1 : 1 is attributed to a resonance group of neutrons of energy $0{\cdot}1$–$5{\cdot}9 \times 10^6$ eV. Comparison of I_{Be} with the source surrounded by paraffin (*a*), and not so surrounded (*b*), after passing through screens of various materials shows that (*a*) is strongly absorbed by B, Ag, Cl and Hg, and less so by Be, C, Al, Fe or Cu, while (*b*) after passing through small thicknesses of C, Al or Pb is increased, the effect resembling that of passage through a hydrogen containing medium.
C. A. S.

1896. Artificial Radioactivity of Iridium. L. Sosnowski. *Comptes Rendus*, 200. *pp*. 922–924, *March* 11, 1935.—With a similar method [see Abstract 1319 (1935)] Ir showed intense radioactivity of periods 50 min. and 3 days, of relative intensities (in the limit) 6 : 1. Both forms consist at least mainly of β-rays, the intensities of which are diminished to one-half by 0·14 and 0·059 gm./cm.² Al, implying energies of $1{\cdot}1$ and $0{\cdot}4 \times 10^6$ eV respectively. Together with this γ-radiation of period 50 min. was observed, the coefficient of absorption of which in Pb was $2{\cdot}2$ cm.$^{-1}$, equivalent to an energy of $0{\cdot}4 \times 10^6$ eV. It is inferred that Ir consists of two isotopes, which by absorption of neutrons and emission of an electron are transformed into corresponding isotopes of Pt. These results differ from those of Fermi. [See following Abstract.]
C. A. S.

1897. Artificial Radioactivity of Bismuth. L. Sosnowski. *Comptes Rendus*, 200. *pp*. 1027–1030, *March* 18, 1935.—When irradiated in the same way [see preceding Abstract] for 6–12 hr. bismuth showed radioactivity of period about 1 hr., apparently consisting solely of β-rays of energy 10^6 eV. Chemical examination of the product showed no trace of an isotope of either Tl or Pb. Consequently capture of the neutron was accompanied by emission of neither a proton nor an α-particle. The reaction is therefore probably $Bi^{209}_{83} + n^1_0 \rightarrow Bi^{210}_{83}$, the result being an isotope of Ra-E. In a note **M. de Broglie** urges that the nuclear properties of elements of the same atomic number can differentiate them profoundly, as illustrated by the two radioactive forms of P of periods 3 min. and 15 days, and emitting positive and negative electrons respectively.
C. A. S.

1898. Artificial Radioactivity Produced by Deuton Bombardment of Nitrogen. E. McMillan and M. S. Livingston. *Phys. Rev.* 47. *pp*. 452–457, *March* 15, 1935.—This paper describes the work leading to the discovery and investigation of radio-oxygen, and also includes some incidental results on other nuclear disintegrations. It is shown that nitrogen bombarded with deutons gives rise to a radioactive substance which emits positive electrons of maximum energy $1\cdot2$ MV, has a half-life of 126 ± 5 sec., and is found by chemical analysis to be an isotope of oxygen. The nuclear cross-section for the activation of nitrogen at 2 MV deuton energy is 6×10^{-27} cm^2; that for the activation of carbon is three times as great. The neutrons expected to accompany the formation of radio-oxygen were found to be present. These results were obtained using gaseous nitrogen as a target; in some of the experiments use was made of the fact that the active product can be deposited on a metal surface by recoil. AUTHORS.

1899. Artificial Radioactivity Produced by Neutron Bombardment. Part II. E. Amaldi, O. D'Agostino, E. Fermi, B. Pontecorvo, F. Rasetti and E. Segrè. *Roy. Soc., Proc.* 149*A*. *pp.* 522–558, *April* 10, 1935.—Previous results [see Abstract 3975 (1934)] have been repeated and extended by the use of an ionisation chamber for detection and insertion between source of neutrons and irradiated substance of, or surrounding both by, H containing material. The intensifying effect of the latter is due to scattering and slowing down of the neutrons by collison with H nuclei, each such reducing the energy by the factor $1/e$. The ratio of increase (α) in radioactivity thus effected varies from 1 (no effect) to 40 (V), and the absorption of such neutrons is much $>$ that of fast ones, *e.g.*, with B $\nless$ 1000 times. Absorption of slow neutrons sometimes causes (*e.g.*, by Co, Cd, Y, Cl, Au) emission of γ-rays when none were observed with fast ones. Non-H-containing materials (*e.g.*, Pb, SiO_2, C but not Fe), have similar but much smaller effects. The probable mechanism is capture of a neutron with formation of a radioactive isotope of atomic weight $A + 1$ followed in the case of light elements (B, Li) by emission of heavy particles, in that of heavy ones of a γ-ray. The theory is discussed and it is inferred that neutrons of velocity $<$ a certain limit have a constant mean free path for elastic collisions and a constant mean life before capture. Results for 59 elements are discussed (in 19 cases the radioactive product was identified chemically), and a table given incorporating previous and present results. Additional radioactive products have been found from 21 elements, in many cases the periods of those previously known have been more accurately determined, and in all the half thickness for absorption of slow neutrons ascertained. Results with U were specially examined. These confirm the production of 4 products with periods of 15 sec. (*a*), 40 sec. (*b*), 13 min. (*c*) and 100 min. (*d*). Comparison of the values of α and the decay curves imply that (*b*) is due to one primary process, and (*a*), (*c*) and (*d*) to another and independent one. Chemical examination showed definite differences from protactinium [see following Abstract], and slight differences between (*c*) and (*d*). The "simplest interpretation consistent with all the facts is that (*a*), (*c*) and (*d*) are chain products probably with atomic numbers 92, 93 and 94 respectively and atomic weight 239." C. A. S.

1900. Identity of Fermi's Reactions of Element 93 with Those of Element 91. A. V. Grosse and M. S. Agruss. *Am. Chem. Soc., J.* 57. *pp.* 438–439, *March*, 1935.—Fermi's experiments, considered to prove the formation of element 93 [see Abstracts 3232 and 3975 (1934)], were repeated with MnO_2 and Re_2S_7 as carriers, but using Pa (No. 91) as indicator. The results were identical with those of Fermi within the limits of experimental error. On the other hand Fermi has since found that his element 93 is not, as Pa is, co-precipitated with zirconium phosphate, but that, contrary to expectation for No. 93, it is precipitated from alkaline solution. [See preceding Abstract and following Abstract.] C. A. S.

1901. Chemical Properties of Elements 93 and 94. A. V. Grosse. *Am. Chem. Soc., J.* 57. *pp.* 440–441, *March,* 1935.—The probable properties of elements 93 and 94 may be predicted either on the assumption that they are the next members of the groups now ending with Re and Os respectively, the additional electrons being in one of the two outermost rings, or that they begin a second group of "rare earth" elements, with the additional electrons in a lower quantum level and so not available as valency electrons, in which case, U corresponding with Ce, elements 93 and 94, etc., would have properties very similar to those of 91, just as Pr, Nd, etc., are practically identical with La. [See preceding Abstract.] C. A. S.

1902. Heavy Hydrogen. O. Specchia and N. Dallaporta. *Elettrotecnica,* 22. *pp.* 122–127, *Feb.* 25, 1935.—An account is given of various experiments which have led to the discovery of H^2. The spectroscopic properties of the new element are noted, and also various methods of isolating it. A short description is given of the method of obtaining heavy water, of its decomposition with the isolation of H^2, and of the employment of the nucleus of the new element as a projectile to produce atomic disintegrations. J. J. S.

1903. Periodic System of Stable Isotopes and Relation of Mass and Charge of Nuclei. J. Selinov. *Phys. Zeits. d. Sowjetunion,* 7. 1. *pp.* 82–98, 1935. *In English.*—The relation between the mass and the charge of nuclei is investigated. A formula is found expressing this relation. The atomic weight calculated according to this formula, as a function of the atomic number, is in approximate agreement with that obtained experimentally. On the basis of this formula, which gives the number and atomic weights of the isotopes, a system of isotopes is built, with which it is possible to predict a series of new isotopes, for instance the isotopes of the rare earths, and to determine the number of single isotopes. A periodicity in the system of isotopes is established and the calculated mass defect curve gives clearly defined kinks, confirming the periodicity of the system. AUTHOR.

1904. Isotopic Constitution and Atomic Weights of Hf, Th, Rh, Ti, Zr, Ca, Ga, Ag, C, Ni, Cd, Fe and In. F. W. Aston. *Roy. Soc., Proc.* 149. *pp.* 396–405, *April* 1, 1935.—The mass spectrum analyses of 13 elements are described, some by the use of the very favourable setting of an anode ray generator already used for the rare earths, others by the ordinary discharge with improved technique. In the course of the experiments some 20 new isotopes were discovered, those of Hf, Th and Rh being detected for the first time. With Cd success was attained in an unexpected manner and gave interesting information on the peculiar behaviour of the discharge in methyl compounds. The values of the chemical atomic weights calculated from photometric measurements are in general in good accord with the international ones. The general situation with regard to the discovery of isotopes and determination of atomic weights is briefly surveyed. AUTHOR.

1905. Canalisation of Neutrons. T. A. Chalmers. *Brit. J. of Radiology,* 8. *pp.* 163–169, *March,* 1935.—Using the Fermi proton effect, neutrons produced by α-particle and by γ-ray bombardment are canalised by the use of tubes with walls of paraffin wax. Using silver as the activated element the factor of canalisation, defined as the ratio of distance in the canal to the distance in air at which the same intensity of activation is produced, is increased by a factor of 4. Subsidiary experiments with a graphite tube show the carbon contributes less than 50 % to the effect. A further experiment with boron which has an abnormally high absorption for slow neutrons shows their mean free path in paraffin wax to be about 1 cm. A right-angled bend in the tube reduces the intensity to one third of that obtained with a straight tube. F. C. C.

1906. Relations between Atomic Number and Atomic Weights. F. Loewinson-Lessing. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 46–54, *Jan.* 1, 1935. *In French.*—If A_z is the atomic weight (round number) of element of atomic number Z, the "atomic difference," δ, is defined as $Z + (Z + 1) - A_z$, and "nuclear excess," Δ, as $A_z - 2Z$. When the values of δ are examined and Δ is plotted against Z, certain regularities are found, whence predictions previously made are claimed to have been fulfilled in the atomic weights of certain elements (Nos. 43, 61, 72, 75, 85 and 87) unknown at that time. It is further predicted that the following elements should have the atomic weights noted after each: Ac 228–230, Pa 234, A 36, Co 58, Ni 60, I 129, La 138, Pr 142, No. 61 146 or 148, Dy 161, Ho 163, Er 167 or 166, Tm 171, and the isotopes of Cl 35 and 36. C. A. S.

1907. Electronic Structure of H_3^+. C. A. Coulson. *Cambridge Phil. Soc., Proc.* 31. *pp.* 244–259, *April*, 1935.—The molecular-orbital method has been applied to a study of H_3^+ in its ground state and excited levels, and the relative importance of the perturbation and variational methods has been considered in some detail. as well as the effect of certain integrals which, in discussions of molecular structure, have often been neglected. It appears that the ion H_3^+ should exist in stable equilateral form with a nuclear distance about 0·85 Å., and that all excited levels are unstable. Reasons are given for supposing that the molecule H_3 is linear and not triangular. AUTHOR.

1908. Molecular Structures by Electron Diffraction. L. E. Sutton and L. O. Brockway. *Am. Chem. Soc., J.* 57. *pp.* 473–483, *March*, 1935.—The molecular structures of the following were determined by the electron diffraction method ($\lambda = 0{\cdot}0606$ Å) [see Abstract 477 (1935)] and the bond distances and angles deduced as follows:

Substance	*Valency angles*	*Bond distances*		
		Experimental		*Calculated for distance in c.5*
1 Cl_2O	ClOCl 111 ±2°	Cl—O 1·71 ±0·02	Cl—Cl 2·82 ±0·03	1·65
2 F_2O	FOF 105 ±5°	F—O 1·36 ±0·1	F—F 2·16 ±0·2	1·30
3 Me_2O	COC 111 ±4°	C—O 1·44 ±0·03	C—C 2·39 ±0·05	1·43
4 dioxane	COC 110 ±5°	C—O 1·46 ±0·04	—	1·43
5 MeCl	—	C—Cl 1·77 ±0·02	—	1·76
6 CH_2Cl_2	ClCCl 111 ±2°	C—Cl 1·77 ±0·03	Cl—Cl 2·92 ±0·02	1·76
7 $CHCl_3$	ClCCl 111 ±2°	C—Cl 1·78 ±0·03	Cl—Cl 2·93 ±0·02	1·76
8 CCl_4	ClCCl 109° 28′	C—Cl 1·76 ±0·005	Cl—Cl 2·87 ±0·01	1·76

These results show that the additivity rule for atomic radii is only approximate, it is followed for C – O in 3 and 4, and for C – Cl in 5, 6, and 7, but not for Cl – O (or F – O) in 1 and 2; that the O valency angle is > that in H_2O when comparatively heavy groups (*e.g.*, Cl or Me) are attached to O as in 1 and 3 [see Abstract 879 (1934)], and similarly ClCCl is > the normal C tetrahedral angle in 6 and 7; and that dioxane is at least mainly in the Z (" chair ") form. Combined with electric dipole measurements they imply that the moment associated with the C – Cl bond in 6 and 7 is only 70 % of its value in 5. C. A. S.

1909. Character of Binding in the CO Molecule. R. J. Jaanus and J. S. Shur. *Phys. Zeits. d. Sowjetunion,* 7. 1. *pp.* 19–25, 1935. *In English.*—A simple method for determining the magnetic susceptibility of gases is described. Results of measurements on CO according to this method are given and the conclusion is drawn that a threefold binding exists between the atoms C and O in the CO molecule. This agrees with the results of other physico-chemical investigations on CO. AUTHORS.

1910. Radical HO_2 in Solution. J. Weiss. *Faraday Soc., Trans.* 31. *pp.* 668–681, *April,* 1935.—In solution the radical HO_2 has previously been assumed in the catalytic decomposition of hydrogen peroxide and in oxidation processes with molecular oxygen. It can be shown that this radical stands in a close relation to ozone, as expressed by the equation: $2HO_2 = O_3 + H_2O + 35$ k.cal. This reaction has been proved for different cases, where the formation of the radical HO_2 is to be expected according to the theory. The inverse reaction is strongly catalysed by hydroxyl ions according to $O_3 + OH^- = HO_2 + O_2^-$, $(O_2^- + H^+ \rightleftharpoons HO_2)$. This reaction accounts for the spectroscopic and chemical behaviour of aqueous ozone solutions which have been investigated in detail. It is further possible to explain quantitatively on this basis the decomposition of ozone in aqueous solution and the reaction between ozone and hydrogen peroxide. In these cases the ozone generally is decomposed in a chain mechanism according to the equations: $O_3 + OH = O_2 + HO_2 + 34$ k.cal., $O_3 + HO_2 = 2O_2 + OH + 33$ k.cal. AUTHOR.

1911. Observations and Calculations of the Dimensions of Atoms. M. Pierucci. *N. Cimento,* 11. *pp.* 690–700, *Dec.,* 1934.—The author's earlier suggestion that at the absolute zero the atomic radius defined as the cube root of the atomic volume may be an integral multiple of a fixed length for all elements, is here reconsidered in the light of recent measurements. Of 29 elements for which the necessary data are available it is now found that 17 have atomic radii differing from integral multiples of $\delta_r = 0{\cdot}0398$ Å by not more than 10 % of δ_r. It is noted that δ_r is of the same order of magnitude as $\lambda_0 = h/m_0c$ when m_0 is put equal to the electronic mass ($\lambda_0 = 0{\cdot}0243$ Å). W. S. S.

1912. Atomic Weights of Several Radiogenic Leads. G. P. Baxter and C. M. Alter. *Am. Chem. Soc., J.* 57. *pp.* 467–471, *March,* 1935.—The atomic weights of radiogenic leads of various origins have been determined: from uraninite (Besner mine, Parry Sound, Ontario) 206·25; pitchblende (Great Bear Lake) 206·06; cyrtolite (Hybla, Ontario) 206·20; cyrtolite (Bedford, New York) I 205·93, II 206·07; galena (Yancy, N. Carolina) 207·21; curite (Katanga) 206·03. Previous results with Pb from cyrtolite had given 205·924 and 205·938 [see Abstract 2674 (1933)], for which variations no explanation is available, as no Th could be detected. There is little evidence of any systematic variation of atomic weight with the probable age of the mineral source. The atomic weight of uranium lead appears to be $\ngtr$ 206·00 [see Abstract 3882 (1933)]. C. A. S.

***1913. Ebullioscopic Determination of Molecular Weights of Non-Volatile Petroleum Fractions. B. J. Mair.** *Bureau of Standards, J. of Research,* 14. *pp.* 345–357, *March,* 1935.—Accurate molecular weights are an essential aid to the chemical investigation of the lubricating oil fraction of petroleum. A modified Cottrell boiling-point apparatus in conjunction with a differential thermoelement has been used to obtain precise values for the boiling-point elevation. The behaviour of *n*-nonacosane, anthracene, triphenylmethane, and two oil samples in "isooctane," *n*-heptane, and benzene, and of biphenyl in benzene has been studied. The ebullioscopic constants or apparent molecular weights have been shown to be a linear function of the concentration. Accurate molecular weights may be obtained if the ebullioscopic constant at infinite dilution is first determined by extrapolation from measurements made over a sufficient range of concentrations. Using this infinite dilution value, the apparent molecular weight of the unknown is computed from observations over a range of concentrations and the molecular weight obtained by extrapolation to infinite dilution. Employing this method, the average value found for the molecular weight of triphenylmethane in "isooctane," *n*-heptane, and benzene was 243·4 compared with the theoretical value 244·14 and for biphenyl in benzene 153·7 compared with 154·08. AUTHOR.

See also Abstracts **1938, 1948, 2093, 2111, 2112, 2119, 2127, 2129, 2130, 2168, 2219, 2231, 2234, 2242, 2252 2254, 2260, 2304.**

COLLOIDS.

1914. Concentration Changes at Membranes and Electroosmotic Membrane Potentials. J. J. Bikerman. *J. Phys. Chem.* 39. *pp.* 243–247, *Feb.,* 1935.—From the theory of the diffuse double layer expressions are derived for both the electrolyte transport and the potential differences at membranes through which an electroosmotic current is driven. These expressions are discussed and compared with the experimental evidence. [See Abstract 4330 (1934).] AUTHOR.

1915. Electrophoretic Velocity and Electric Charge in Hydrophobic Sols. O. Enslin, G. Lindau and R. Rhodius. *Kolloid Zeits.* 70. *pp.* 189–198, *Feb.,* 1935.—The electrophoresis of quartz suspensions in water and in KCl solutions was studied under the microscope by an improved method permitting prolonged observations of individual particles of the suspension, which was contained in a vertical tube of flat section (12 × 1·6 mm.); by adjustment of the direction and intensity of the electric field the particles could be made to rise or fall under the resultant of gravity sedimentation velocity and of electrical drift velocity *u* (μ/sec./volt/cm.), *u* being itself the resultant of electrophoretic drift of the particles and electrical endosmose of the suspension medium. Wide fluctuations in *u* with the same particle (due to its non-sphericity) were found over individual runs, but mean values over a series of runs were consistent to 5 %; the results are compared with those of v. Buzágh [*Kolloid Zeits.* 51. 230, 1930]. Accurate confirmation of v. Smoluchowski's equation for the symmetrical parabolic distribution of *u* across the section of the tube was found for quartz 1 μ dia. and for quartz-albumen aggregates of 4–6 μ dia. Polarisable Pt electrodes were preferred for this work to the customary non-polarisable Cu/$CuSO_4$, Hg/Hg_2Cl_2, in order to avoid interference by stray foreign ions; subsidiary electrodes permitted an accurate measure of the effective volts/cm. in the tube. The charge on a powder may be determined from the change in *u* occurring when the powder is added to a hydrophobic sol and it is shown that the charges are not affected by adsorption potential. L. V. C.

1916. Change of State of Viscous Systems. Part IX. H. Umstätter. *Kolloid Zeits.* 70. *pp.* 174–180, *Feb.*, 1935.—A relationship is shewn to exist between viscosity and time, because the viscosity of semi-solid substances as measured at the beginning of the application of a constant driving force is lower than the constant value arrived at after a given time. This quasi-stationary change in condition is explained on the Maxwell relaxation theory and is illustrated by means of tables and diagrams. A relationship is shewn to exist between the relaxation theory and the damping theory of viscosity, which may have an important bearing on questions concerning the structure of solutions. The theory developed on viscosity-time effect is shewn to be confirmed by previous measurements of Ostwald and Auerbach on cotton gel sols. Very good agreement is obtained between theory and measurement. [See Abstract 1786 (1934) and following Abstract.] J. K.

1917. Change of State of Viscous Systems. Part X. H. Umstätter. *Kolloid Zeits.* 70, *pp.* 285–288, *March*, 1935.—It is shown that turbulence can be explained by means of the elasticity of fluids. Finite values of elasticity necessitate finite values of the velocity of propagation of the friction processes. This velocity is independent of the relaxation time of the molecules and the whole system shows dispersion. The difference of the velocity of propagation of the frictional disturbances gives molecular tension differences which acting together give changes in the transverse stresses and produce turbulence. The turbulence condition is always fulfilled if the laminar, molecular tension differences equal or are greater than the thrust solidity of the lamina. Turbulent motion is always more likely in systems with the greatest relaxation time and becomes apparent in the absorbing boundary layers. [See preceding Abstract.] G. F. P. T.

1918. Diffusion of Colloids. R. O. Herzog. *Zeits. f. phys. Chem.* 172. *Abt. A.* 3. *pp.* 239–241, *Feb.*, 1935.—Lyophilic sols all exhibit to varying degrees swelling phenomena, which complicate diffusion experiments and render invalid the usual diffusion formulæ; the observed effect is described as "pseudo-diffusion." L. V. C.

1919. Specific Volume, Compressibility, and Volume Thermal Expansivity of Rubber-Sulphur Compounds. A. H. Scott. *Bureau of Standards, J. of Research,* 14. *pp.* 99–120, *Feb.*, 1935.—The specific volume, compressibility, and volume thermal expansivity of rubber-sulphur specimens containing from 3 to 31 % of sulphur have been determined at temperatures from 10° to 85° C. for pressures up to 790 atmospheres. The specific volume was determined at atmospheric pressure by a pyknometer; at other pressures from measurements of the lengths of rods of the materials as the pressures were applied. The compressibilities and volume thermal expansivities were derived from these results. J. K.

***1920. Viscosity and Plasticity of Disperse Systems. Part I. Determination of the Constants of Plastic Flow of Clay Suspensions. M. P. Wolarowitsch and D. M. Tolstoi.** *Kolloid Zeits.* 70. *pp.* 165–174, *Feb.*, 1935.—It is shown that Bingham's theory of plastic flow, according to which the plastic properties of a substance can be expressed by two physical constants, can be applied to clay suspensions. A process is worked out to determine the absolute values of these constants, based upon the coaxial cylinder method. A specially constructed apparatus of the simplest construction is employed. It is shown that, within the limits of error of measurement, the constants of plastic flow in the equation $dv/dg = (1/n)\ (\tau - \theta)$ do not depend upon the deformation velocity and the dimensions of the apparatus. J. K.

1921. Influence of the Electrical Field on the Viscosity of Colloid Solutions. A. Passynski. *Kolloid Zeits.* 70. *pp.* 180–188, *Feb.*, 1935. —The changes produced in dielectrical and mechanical properties of 1–3 % solutions of rubber are determined for the application of a static electric field on a flowing liquid. The theory of Debye is applied to the case of the simultaneous action of two forces on polarised rubber particles. An effect is shown to exist analogous to that of an increase in viscosity of solutions in a d.c. field (the outer electric viscosity effect), an effect found by Herzog, Kudar and Paersch for a few organic fluids. The change in outer electro viscosity effect is determined with respect to difference of potential of the electric field, rate of flow of the fluid, concentration, temperature, and action of an a.c. field. The results obtained are interpreted from the standpoint of elastic deformation of colloidal structure in solutions under the action of an electric field. The possibility of interpretation based on orientation of elementary colloid particles is also discussed. J. K.

1922. Viscous Elasticity. E. Madelung and S. Flügge. *Ann. d. Physik,* 22. 3. *pp.* 209–222, *March,* 1935.—It is shown that substances which possess form-elasticity as well as viscous properties (*e.g.* gels) can be described by means of a complex elasticity modulus so far as periodic movements are concerned. This modulus is frequency-dependent, so that the problem can be investigated within elasticity considerations as the dispersion theory of elastic waves. In order to decide upon the suitable form of procedure, an experimental method has been devised and certain measurements are communicated with respect to glycerin and gelatin. H. H. Ho.

1923. Arrangement of Micelles and Deformation of Fibre Materials. O. Kratky. *Kolloid Zeits.* 70. *pp.* 14–19, *Jan.*, 1935.—X-ray photographs are given for swollen cellulose amyloxalate films, in the dry condition and for films swollen in dioxan of increasing concentration; and for stretched films of cellulose ethyloxalate. Various formulæ are proposed for simple and complex stretching respectively of highly swollen ester films. [See Abstract 4394 (1934).] J. K.

***1924. Cellophane and Cuprophane as Membranes for Dialysis and Electrodialysis. H. Brintzinger and H. Osswald.** *Kolloid Zeits.* 70. *pp.* 198–200, *Feb.*, 1935.—The cellophane and cuprophane used commercially as packing materials are eminently suitable for dialysis membranes having, respectively, permeabilities four and eight times that of a typical parchment. Their mechanical strength is high in spite of their low thicknesses (20 μ and 10 μ respectively). L. V. C.

1925. Disperse Systems from the Technical Standpoint. H. W. Gonell. *Kolloid Zeits.* 70. *pp.* 31–38, *Jan.*, 1935.—A general paper not lending itself easily to abstraction. Data are given concerning the yearly production of fine and coarse products, such as cement, chalk, gypsum, carbon black, rubber compounding ingredients, wood flour, potato flour. The systems dust-gas and dust-fluid are considered in some detail and data are borrowed from Memmler's book on rubber to show the importance of content of compounding ingredients on the physical properties of vulcanised rubber. J. K.

See also Abstracts 1938, 1968, 2155, 2208.

CRYSTAL STRUCTURE AND PROPERTIES.

1926. Comparison of Electrostatic Energies of an Ionic Lattice. F. Hund. *Zeits. f. Physik*, 94. 1–2. *pp.* 11–21, *March* 12, 1935.—The electrostatic energies of a number of naturally occurring crystal lattices as well as of lattices not found in nature are calculated by a method due to P. Ewald. For lattices of great symmetry, the lattice energy is found to be dependent only on the coordination number. An interpretation of the various types of lattice is given on the basis of an ideal crystal model. H. J. H. S.

1927. Spectrum of the Normal Frequencies of a Polar Crystal Lattice. Part I. General Theory. J. H. C. Thompson. *Roy. Soc., Proc.* 149*A*. *pp.* 487–505, *April* 10, 1935.—The dynamical theory of the vibrations of the particles in a polar crystal lattice is worked out. A determinantal frequency equation, for the determination of a typical set of points of the " frequency spectrum," is obtained in a form in which the coefficients can be calculated. [See Abstract 40 (1935).] AUTHOR.

1928. Hume-Rothery Rule for Intermetallic Compounds. U. Dehlinger. *Zeits. f. Physik*, 94. 3–4. *pp.* 231–240, *March* 19, 1935.—Jones has shown that for the γ-structure the lowest group of energy levels is almost completely filled by the number of loosely bound electrons given by the Hume-Rothery rule [see Abstract 1690 (1934)]. Similar calculations show that an even better agreement is obtained for the ϵ-phase (hexagonal). That obtained for the β-phase (body-centred cubic) is not so good. The theoretical significance of these results is discussed. J. T.

1929. Structure of Ag-Ca Alloys. C. Degard. *Zeits. f. Krist.* 90. *pp.* 399–407, *May*, 1935. *In French.*—Alloys of Ag and Ca are prepared in vacuum and examined by the powder method. The hypothetical compounds Ag_4Ca, Ag_2Ca and $AgCa_2$ are not found, but the existence of the compounds AgCa and Ag_3Ca is established. The alloy corresponding to the composition $AgCa_4$ is found to be a eutectic, being a mixture of AgCa and Ca. Ag_3Ca is tetragonal with $c/a = 0{\cdot}88$. AgCa is not body-centred cubic as would be required by the Hume-Rothery rule, but is face-centred cubic with $a = 9{\cdot}07$ Å. The ratio of the atomic radii of Ag and Ca lies within the limits given by Goldschmidt for a face-centred cubic structure. J. T.

1930. Nickel-Manganese System. S. Valentiner and G. Becker. *Zeits. f. Physik*, 93. 11–12. *pp.* 795–803, *Feb.* 26, 1935.—The Ni-Mn system of alloys is examined magnetically, electrically and by X-ray analysis. The magnetism of the super-structural alloy Ni_3Mn (containing about 25 % of Mn) is found to be strongly paramagnetic in character. The increased electrical conductivity of the alloys containing about 50 % of Mn is attributable to the presence of NiMn; this is confirmed by X-ray analysis. J. S. G. T.

***1931. X-Ray Examination of Non-Ferrous Metals. W. E. Schmid.** *Zeits. f. Metallkunde*, 27. *pp.* 49–62, *March*, 1935.—A survey is given of X-ray work done on non-ferrous metals. Straightforward structure determinations of alloys are first dealt with. It is shown how such work leads to information concerning the nature of the metallic bond.

The help given by X-rays in the determination and testing of equilibrium diagrams is then discussed. Various changes in crystalline state are considered (*e.g.*, temperature effects and allotropy). Next comes an account of crystal orientation due to cold work, together with a discussion of the mechanism of plastic deformation and recrystallisation. The subjects of elastic strain and lattice deformation are then dealt with, and investigations on corrosion at the surfaces of binary mixed crystals are described. Finally, a description is given of typical apparatus used in the examination of metals by X-ray diffraction methods. J. T.

1932. Structure of Cæsium Cobalt Chloride. H. M. Powell and A. F. Wells. *Chem. Soc., J. pp.* 359–362, *March*, 1935.—Cs_3CoCl_5 is tetragonal with *a* 9·18, *c* 14·47 Å, d^{20} 3·39, and 4 mols. in the unit cell; space group I $4/mcm(D_{4h}^{18})$. The Co is tetra- and not penta-coordinated with 4Cl arranged tetrahedrally around each Co atom (Co—Cl = 2·34 Å) while the fifth Cl^- ion is far removed. The salt should be formulated Cs_3^{+++} $[CoCl_4]^{--}Cl^-$. This is further confirmed by the unstable corresponding Rb salt, which is isomorphous with *a* 8·7, *c* 14·0 Å. The Cs atoms are in two groups: I with 10 Cl, at 3·67 (8), and 3·6 Å (2), and II with 8Cl, at 3·4 (2), 3·39 (2) and 3·85 Å (4). C. A. S.

1933. Structure of Cæsium Enneachlordithalliate, $Cs_3Tl_2Cl_9$. J. L. Hoard and L. Goldstein. *J. Chem. Phys.* 3. *pp.* 199–202, *April*, 1935.—$Cs_3Tl_2Cl_9$ is shown to possess a rhombohedral unit of structure with $a_0 = 9\cdot58$ Å, $\alpha = 83° 48'$, containing two molecules. The crystals exhibit extensive and quite perfect 60° twinning on the basal plane, so that most specimens simulate complete sixfold symmetry, but when this is taken into consideration, a structure based upon $D_{3d}{}^6 - R\,\bar{3}\,c$ accounts well for observed intensity data. The structure may be described conveniently as an aggregate of Cs^+ and $Tl_2Cl_9{}^{-3}$ groups packed together in such manner that all large atoms fit into an approximately closest-packed arrangement. The $Tl_2Cl_9{}^{-3}$ group is considered to be a covalent complex. The derived structure is compared with the known structures of $Cs_3As_2Cl_9$ and $KMgF_3$. AUTHORS.

1934. Structure of Diaspore. F. J. Ewing. *J. Chem. Phys.* 3. *pp.* 203–207, *April*, 1935.—The parameters in diaspore are redetermined, and the structure is discussed from the standpoint of the coordination theory. The existence and location of hydrogen bonds in the structure are established, and representative formulæ are proposed. AUTHOR.

1935. Symmetry and Structure of the Crystals of the Hydrochlorides of Triaminotriethylamine. F. M. Jaeger and J. Beintema. *K. Akad. Amsterdam, Proc.* 38. 3. *pp.* 243–256, 1935.—The anhydrous trihydrochloride, $N(C_2H_4NH_3Cl)_3$, forms cubic crystals of the tetrahedral-pentagondodecahedral class of symmetry group T; $a_0 = 10\cdot75$ Å; specific gravity = 1·32, the calculated value being 1·35; the unit cell contains four molecules. The other hydrochloride, $N(C_2H_4NH_3Cl)_3$, $HCl + H_2O$, forms hexagonal crystals which are tetartohedral and belong to the hexagonal-pyramidal class; $a_0 = 9\cdot3$ Å, $c_0 = 30\cdot0$ Å; specific gravity = 1·37; the unit cell contains six molecules, which, with respect to each other, appear to be shifted over one-sixth of the height of the cell in the direction of the *c*-axis. T. H. P.

1936. Structure of Barium Dicalcium Propionate. I. Nitta and T. Watanabe. *Inst. Phys. & Chem. Research, Tokyo. Sci. Papers No.* 556. *pp.* 164–177, *Feb.*, 1935. *In English.*—$BaCa_2(C_2H_5CO_2)_6$, *d* 1·45, is cubic, the unit cell has *a* 18·20 Å, and contains 8 molecules, space group

O^7_h–*Fd3m*. The Ba atoms form a diamond lattice, each surrounded octahedrally by 12 O atoms in pairs (Ba–O = 3·11 Å); the Ca atoms are placed equidistant from the nearest Ba atoms, and each is surrounded approximately octahedrally by 6 O atoms (Ca–O = 2·23 Å). Each Ba and Ca is surrounded by 6 $CH_3 \cdot CH_2 \cdot COO$ groups, in which $\alpha C - \beta C = 1 \cdot 54$, C–O = 1·24, and O–O = 2·16 Å, and the CH_3 groups rotate freely. The crystal is ionic. [See also following Abstract.]

C. A. S.

1937. Structure of Calcium Barium Propionate. L. P. Biefeld and P. M. Harris. *Am. Chem. Soc., J.* 57. *pp.* 396–399, *March*, 1935.—The density of calcium barium propionate was found to be 1·44 gm./cc. at 27°. The salt crystallises in the cubic system with $a_0 = 18 \cdot 3 \pm 0 \cdot 1$ Å, the unit cell containing eight molecules of the double salt. The crystal has the symmetry of O^4. This requires that the propionate group have a 2-fold axis of symmetry. The positions of the Ba and Ca ions are determined directly from the X-ray data and the approximate locations of the other atoms are inferred. The resulting arrangement is a type of coordination structure of Ba and Ca ions with the oxygens of the propionate groups. [See preceding Abstract.] AUTHORS.

1938. X-Rays and the Coarse Structure of Materials. W. H. Bragg. *Brit. J. of Radiology*, 8. *pp.* 144–154, *March*, 1935. *Mackenzie Davidson Memorial Lecture.*—The use of X-rays in investigating the structure of solid matter is described. Particular attention is paid to organic structures, cellulose, hair, wool and rubber being considered. The results of the investigation of the structure of durene by Fourier analysis are presented in the form of " contour maps " showing the electron configuration. The general problem of the structure of organic molecules is discussed. J. T.

1939. Strength of Materials. W. H. Bragg. *Roy. Inst., Proc.* [22 *pp.*], *Advance copy received March*, 1935.—It is shown how the crystal structures of substances such as cyanuric triazide and benzoquinone explain many previously known properties of these substances. The calculated strengths of crystals are however far greater than the observed strengths. This is considered to be due to some factor not connected with the crystal structure itself. A short account of current theories on this subject is given. J. T.

1940. Threads and Vortices in Nematic Liquids. V. Naggiar. *Comptes Rendus*, 200. *pp.* 903–905, *March* 11, 1935.—The threads that appear in a nematic liquid exposed to an electric field are a secondary effect due to the vortical convection currents produced by the field in the liquid, which is feebly conducting. They are specially apparent in a steady field, but also in an alternating one of 200–300 V/cm., provided the frequency is $\ngtr$ 50/sec. Similar threads are produced by convection currents caused by heat. [See Abstract 3572 (1932).] C. A. S.

1941. Modifications of the Habit of Phloroglucinol Crystals by Colouring Matters and Action of Heat on the Coloration. P. Gaubert. *Comptes Rendus*, 200. *pp.* 1120–1122, *March* 25, 1935.—These modifications may result from two different processes: (1) Syncrystallisation of the foreign material with the substance, and (2) formation of a solid solution, the colouring matter having none of its crystalline properties in the common structure, which is that of the predominant substance. Examples of case (2) are the following. Rhombic crystals of hydrated phloroglucinol show usually the forms (001), (110) and (101),

the plane of the optic axes being in (001). Addition of less than 0·1 % of one of various dyestuffs to the mother liquor colours the crystals and modifies the habit in two ways: (*a*) with methylene blue, neutral red, etc., the crystals are elongated along the edge between (001) and (101) and are often grouped along (100) to form strips elongated along the *a* axis. (2) Toluidine blue, magenta, etc., lead to crystals flattened along (100) and elongated along the *b* axis. These effects increase with the slowness of crystallisation. When heated in the air, the crystals begin to lose their water at 50° C. and become opaque owing to the formation of small crystals, which show orientation only if the original hydrated crystals are attached to a glass plate. Diminution of the polychroism occurs under the influence of heat, this change being, to some extent, reversible.
T. H. P.

1942. Number of Colour Centres in Crystals. E. Mollwo and W. Roos. *Göttingen Nachrichten,* 1. 8. *Fachgruppe* 2. *pp.* 107–113, 1934.—Two methods, electrical and optical, of determining the number of colour centres in crystals are described. The authors have repeated Stasiw's comparison of the two methods and confirm his statement that they agree within a small percentage. Yet it is considered that this agreement of the two methods must not be taken as proof of their correctness. It seems probable that a factor of magnitude between 1 and 2 should be annexed to the two formulæ expressing the number of colour centres.
J. J. S.

1943. Natural Blue Rock-Salt. Rate of Growth and Colouring. K. Przibram. *Akad. Wiss. Wien, Ber.* 143. 2*a*. 8–10. *pp.* 489–497, 1934.—In blue rock-salt from the Grimberg mine near Heringen, Thuringia, pyramids of growth can be clearly discerned in the colouring. The crystals along different cubic axes grow at different rates, whereby repeated sudden changes of relations of rate occur. The more rapidly growing pyramids show darker and more blue colours, the slower brighter and more violet colours. These observations agree with the conception that the colouring is connected with disturbances of the lattice; they can be reproduced in colourless, natural, elongated rock-salt prisms by artificial coloration, whereby light can be thrown on the way of growth of this noteworthy formation. [See Abstract 2342 (1933).]
J. J. S.

1944. Plasticity of Crystals. P. Duwez. *Phys. Rev.* 47. *pp.* 494–501, *March* 15, 1935.—A theory is given with the purpose of establishing a mathematical relation between the stress and the strain in a crystal when plastically deformed. The existence of a " secondary structure " in crystals is adopted as a basic hypothesis. This structure was pointed out by F. Zwicky to be a consequence of what he calls " cooperative phenomena." The assumption that gliding in crystals takes place between the blocks of the secondary structure is the starting point of the theory. The additional hypothesis of assuming a statistical distribution of the different forces which produce gliding between the blocks, gives us the means for going further in the calculations. The final result which is the stress strain curve of a crystal, is an exponential law containing three constants, *i.e.*, the torsional modulus *G*, the elastic limit (γ_s, τ_s) and the maximum applicable stress τ_m. The form of the hysteresis cycles is deduced from the same considerations and moreover a formula is obtained for the areas of the cycles. Experimental verifications were made on a single crystal of copper, and also on ordinary microcrystalline copper. AUTHOR.

1945. Behaviour of Three Single Crystals of Aluminium in Fatigue under Complex Stresses. H. L. Cox and W. J. Clenshaw. *Roy. Soc., Proc.* 149A. *pp.* 312–326, *April* 1, 1935.—The recent development at the National Physical Laboratory of a new type of combined flexural and torsional fatigue testing machine has made it possible to carry out tests under alternating flexural stresses on single crystal specimens. Three single crystal specimens all of the same orientation have been tested, one under alternating flexural, one under alternating torsional and the other under a combination of alternating flexural and alternating torsional stresses. The distribution of slip bands on each specimen was entirely in accordance with that predicted from the calculated values of the shear stresses according to the resolved shear stress law, and the results thus afford evidence of the validity of this law in cases where the stress distribution is not simple. Measurements of the mean slip band spacing have been made and the relation between mean slip band spacing and the value of the resolved stress has been examined. The fracture of the specimens has been shown to occur in the normal manner by the development of cracks formed on the site of previous heavy slip, and the dependence of failure on the value of the *resolved* shear stress has been demonstrated.

AUTHORS.

1946. Residual Distortion in Steels. G. L. Clark and M. M. Beckwith. *Zeits. f. Krist.* 90. *pp.* 392–398, *May*, 1935. *In English.*—A method, depending on the shape of X-ray diffraction spots, is given for measuring the amount of residual distortion present in steels. A formula is given for obtaining a modulus which denotes the degree of perfection of the grains. An iron-silicon electric steel is investigated, and it is found that magnetic permeability is influenced by residual distortion. J. T.

1947. Axis of Curvature of Bent Crystals. W. Boas and H. Ekstein. *Zeits. f. Krist.* 90. *pp.* 408–414, *May*, 1935. *In German.*—It is assumed that asterism in Laue photographs is due to the bending of the reflecting planes about an axis of curvature. A method is given for the determination of the position of this axis from transmission and back-reflection photographs. Indexing of the photographs is not necessary. The case of a drawn crystal of zinc is worked out as an example.

J. T.

See also Abstracts 1924, 2056, 2219, 2239, 2269, 2275.

DENSITY.

***1948. Distribution of Isotopic Water in the Sea. H. E. Wirth, T. G. Thompson and C. L. Utterback.** *Am. Chem. Soc., J.* 57. *pp.* 400–404, *March*, 1935.—An apparatus for measuring small differences in density is described. The sensitivity is of the order of 10^{-8}, but determinations are reported only to 10^{-7}. The average difference in density between water distilled from sea water and from tap water was found to be $1 \cdot 3_7 \times 10^{-6}$ for 31 samples. Waters from different depths of the Indian Ocean, Red Sea, and Mediterranean Sea were very uniform, with the exception of one sample taken at 4000 m. in the Indian Ocean, which showed a greater density difference, $1 \cdot 6_7 \times 10^{-6}$. Waters of the Baltic showed very low density differences varying from $0 \cdot 2$ to $0 \cdot 5 \times 10^{-6}$. These low values were attributed to marked dilution by land drainage. The two samples from the Antarctic Ocean showed a density difference less than that of the Indian Ocean, $1 \cdot 0 \times 10^{-6}$ at the surface and $1 \cdot 2 \times 10^{-6}$ at 3200 m. At a station in the North-East Pacific where

13 samples were secured simultaneously at different depths from the surface to 2000 m., density differences were observed that varied from $1 \cdot 1_2 \times 10^{-6}$ to $1 \cdot 6_7 \times 10^{-6}$. A region in the San Juan Archipelago, noted for its abundant fauna and flora, yielded waters of very low density differences and of the order of $0 \cdot 8 \times 10^{-6}$. AUTHORS.

See also Abstract 2226.

DIFFUSION AND OSMOSIS.

1949. Theory of Diffusion of Electrolytes. M. Planck. *Zeits. f. Physik*, 93. 9–10. *pp.* 696–698, *Feb.* 14, 1935.—In an earlier paper [see Abstract 74 (1935)] theories developed by P. Henderson and by M. Planck concerning the p.d. between electrolytes were criticised. The author discusses Sitte's objections and points out that the latter uses incompatible formulæ in his own theory. **K. Sitte** (*ibid. pp.* 698–701) in reply, examines these formulæ again and although he admits that one of his assumptions is formally incorrect, like every other subsidiary condition that has been introduced, also elsewhere, he claims that his results give a better approximation to actual experimental findings. H. L. B.

1950. Interdiffusion of Gases at High Pressures. B. Kries and N. Zeljakoff. *Zeits. f. Physik*, 94. 1–2. *pp.* 134–138, *March* 12, 1935.—The rate of interdiffusion of gases at high pressures is investigated theoretically and the results are compared with experimental values obtained when air and CO_2 diffuse in a cylinder 160 cm. high at a total pressure of 50 atmospheres. The period of diffusion is varied from 24 to 120 hr., corresponding to up to 30 % interdiffusion; good agreement between theory and experiment is obtained over the entire range. F. C. C.

1951. Diffusion of Mercury on Tin. T. Alty and A. R. Clark. *Faraday Soc., Trans.* 31. *pp.* 648–659, *April*, 1935.—The diffusion of mercury in tin has been examined. It has been shown that this diffusion consists of a rapid surface diffusion accompanied by a much slower volume diffusion. The surface phenomenon has been studied in detail and appears to be a true diffusion in that it obeys an ordinary diffusion equation. The variation of the rate of diffusion with temperature also obeys the same law as that of an adsorbed film, and the energy of activation of the mobile atoms on a pure tin surface is found to be $E_0 = 1920$ cal./gm. atom. The rate of diffusion is found to be dependent on the nature of the medium surrounding the tin, being faster in water and slower in oil than in air. The diffusion on a surface of tin amalgam containing an atomic percentage of 8 per cent mercury is found have a negative temperature coefficient. [See Abstract 2725 (1933).] AUTHORS.

1952. X-Ray Study of Interdiffusion of Copper and Zinc. E. A. Owen and L. Pickup. *Roy. Soc., Proc.* 149*A*. *pp.* 282–298, *April* 1, 1935.—The interdiffusion of Cu and Zn powders was studied with the help of X-ray analysis. Mixtures of filings of these metals were heated for different times and at different temperatures in evacuated tubes. From the measured parameters of the α-phase the composition of the surface of the particles was obtained by use of a standard parameter-composition curve. Cu-Zn alloys can be prepared by the interdiffusion of filings at temperatures much below the melting point of Cu, but interdiffusion takes place in a reasonable time only when the temperature of diffusion is above the melting point of Zn. Prolonged exposure of the particles to the air retards the rate of diffusion; so also does annealing.

For a given time of interdiffusion there exists a linear relation between the parameter value and the size of the particles. G. E. A.

1953. Origin of Osmotic Pressure and Lowering of Vapour Pressure. K. Fredenhagen. *Phys. Zeits.* 36. *pp.* 194–208, *March* 15, 1935.—Definitions, literature relating to the physico-chemical relationship, and the origin of osmotic pressure and the lowering of vapour pressure are critically discussed. Considerable confusion is shown to exist in these matters, and the author suggests a consistent theory and definitions. [See also Abstract 2731 (1934).] J. S. G. T.

See also Abstracts 1918, 2185.

ELASTICITY AND PLASTICITY.

1954. Components of Deformation and Elastic Potential in Any Coordinate System. E. Volterra. *Accad. Lincei, Atti,* 20. *pp.* 424–428, *Dec.* 2, 1934.—The author establishes formulæ for the deformation components of an elastic body in any general system of curvilinear coordinates, and also an expression for the elastic potential of an isotropic body in terms of these components. The notation of the tensor calculus is used. A. J. McC.

1955. Relation between Fusion and Strength. H. Jeffreys. *Phil. Mag.* 19. *pp.* 840–846, *April,* 1935.—Johnston [see Abstract 231 (1912)] suggested that elastic failure in a solid is the result of real local melting. The idea was further developed by Johnston and Adams [see Abstract 1211 (1913)]. Jeffrey shows that the theory is open to three objections, *viz.* (1) the conditions for its validity appear to be unrealisable; (2) the strength indicated is too high; (3) no explanation is provided of the fact that metals yield almost equally readily to pressure and to tension. The theory however has some good points, *viz.*, it indicates that the strength should vanish at the melting point, as it apparently does for most substances, and that the graph of strength against temperature should be concave upwards, in agreement with Joffe's curves for rock-salt. The geodetic significance of the theory is briefly referred to. J. S. G. T.

1956. Finite Strain in Elastic Problems. B. R. Seth. *Roy. Soc., Phil. Trans.* 234*A*. *pp.* 231–264, April 27, 1935.—The mathematical theory of elasticity, as at present developed, is based on the assumption that the displacements to be considered in elastic solid bodies are so small that the squares and products of the first differential coefficients of u, v and w with respect to x, y, z can be neglected in comparison with their first powers. For this reason it is not satisfactory for many problems where the displacement is finite and the strain produced is not sufficiently small to justify this assumption. To obtain a solution of such a problem the components of strain corresponding with any displacement are first found, the conditions to be satisfied by the displacement and the form of the boundary are stated and criticisms are made of Voigt's extension of the strain energy function. The body examined is assumed to be isotropic. The cases dealt with in detail are (1) a cylinder subjected to a uniform tension T, (2) a rectangular plate bent in the form of a right cylindrical surface, and (3) the torsion of a right circular cylinder. Virtually St. Venant's semi-inverse method has been used in all three cases and frequent applications have been made of his principle of the elastic equivalence of statically equipollent systems of load. R. S. R.

1957. Plastometric Investigations of Highly Consistent Substances. Part III. G. Ungar. *Kolloid Zeits.* 70. *pp.* 277–280, *March,* 1935.—A process is described for the determination of the velocity distribution within a plastic substance in the semi-spherical plastometer and thereafter the construction of a curve which will afford the shear gradient–shear force relationship $\tau = f(y)$. The validity of the method is experimentally established, and various modifications are described for application to highly viscous masses. [See also Abstract 85 (1935).]
H. H. Ho.

1958. Transverse Oscillations of Beams Under the Action of Moving Variable Loads. A. N. Lowan. *Phil. Mag.* 19. *pp.* 708–715, *March,* 1935.—The problem of transverse oscillations of beams under the action of loads moving according to any arbitrarily prescribed law of motion is rigorously solved by a method presented in an earlier paper by the author. [See Abstract 3059 (1934).] H. L. B.

***1959. Impact Strength Tester. B. Moore.** *Journ. Sci. Instruments,* 12. *pp.* 108–111, *April,* 1935.—A method, employing a self-contained, portable instrument, which is easily manipulated, is described of measuring the resistance of materials to fracture by impact. Results, obtained with transparent fused quartz, are shown and indicate that the method may be used to obtain reliable and consistent measurements.
AUTHOR.

See also Abstract 1939.

GRAVITATION.

1960. Absolute Definition and Physical Significance of Hubble's Constant. L. Laboccetta. *Acad. Lincei., Atti,* 20. *pp.* 429–433, *Dec.* 2, 1934.—Using Hubble's constant the distance r can be calculated at which the velocity of recession of a nebula would equal the velocity of light. It is pointed out that this distance agrees closely with the figure obtained by multiplying the total number of elementary atoms in the universe, by the radius of the atomic sphere associated with the atom by a method described in a previous paper [see Abstract 1401 (1935)]. Taking this empirical correspondence as basis, the physical significance of Hubble's constant in the author's system of absolute gravitational units is discussed.
W. S. S.

1961. Isostasy in India. E. A. Glennie. *Gerlands Beitr. z. Geophys.* 43. 4. *pp.* 340–345, 1935. *In English.*—W. Bowie's paper [see Abstract 1835 (1934)] is discussed, and it is shown that by selecting a different orientation of zones a very different picture of the isostatic anomalies in India results. This is evidently not due to local effects, but to broad, deep-seated, uncompensated warpings of the inner crustal layers, and is therefore unfavourable to the existence of an isostatic condition in India. New data are included, extending the area examined to Ceylon and the Maldive and Laccadive Islands. AUTHOR.

See also Abstracts 1996, 2021.

HYDRODYNAMICS AND AERODYNAMICS.

1962. Frontiers of Aerodynamics. H. L. Dryden. *Washington Acad. Sci., J.* 25. *pp.* 101–122, *March* 15, 1935.—A review is given of the present situation on three frontiers of aerodynamics. Most attention is given to the unsolved problems of the science itself. The specialised sciences, such as meteorology, oceanography, hydrodynamics, heat transfer, etc., are considered in their present form. The third section deals with aerodynamics from the engineering point of view. The measurements and theory of the distribution of speed near skin-friction plates are described. The theories of Prandtl and Kármán for turbulent flow are commented upon. The application of the laws of turbulent friction to atmospheric phenomena is discussed. The connections between aerodynamics and the practical art of ventilation and the design of windmills are indicated. The determination of the wind pressure exerted on structures in wind storms and the application of aerodynamical principles to the stream-lining of automobiles and trains are also given. G. F. P. T.

1963. Effect of an Oscillation on the Wake of an Immersed Body. C. Camichel and M. Teissié-Solier. *Comptes Rendus,* 200. *pp.* 704–707, *Feb* 25, 1935.—In a previous paper on the alternate vortices of Kármán the Reynolds number R and the dimensionless parameter $S = D/VT$, called the Strouhal parameter, have been used. It was shown that Reynolds' similarity law applied, and a criterion for R for the case of a circular cylinder was given. The present paper shows that a new fact can be obtained in connection with the influence of an oscillation on the wake in the Poiseuille region of an immersed body. A demonstration is given of the existence of a periodic phenomenon, which is the continuation of the phenomenon of alternate vortices. These results confirm and extend those obtained previously. G. F. P. T.

1964. Viscous Fluids and Propagated Waves. S. de Backer. *Comptes Rendus,* 200. *pp.* 899–901, *March* 11, 1935.—Lampariello has shown that viscous fluids which are controlled by the classical equations of Stokes cannot apparently be considered as containing propagated real waves in the sense of Hadamard. It is shown by means of a general transformation of the tensor form of the equations that a viscous fluid can propagate such waves of order three or more. The velocity of propagation is obtained in terms of the density and pressure. The paper is entirely mathematical. G. F. P. T.

1965. Ship Waves. Relative Efficiency of Bow and Stern. T. H. Havelock. *Roy. Soc., Proc.* 149*A*. *pp.* 417–426, *April* 10, 1935.—The main effect of fluid friction in regard to the production of waves by a ship may be described as a decreasing efficiency of elements of the ship's surface with increasing distance from the bow. A reducing factor of a semi-empirical nature, is introduced into the theory of ship waves to represent this effect. With certain assumptions, calculations are made for the wave profile for a simple model, and curves are also given; these are compared with available experimental data. It appears that, as a rough estimate for such forms at moderate speeds, the efficiency of the stern is of the order of 60 % of that of the bow. Curves are also drawn to show the corresponding change in the wave resistance. The introduction of the reducing factor leads to different wave resistances for a model going ahead and going astern, when the model is not symmetrical fore and aft; this is illustrated by calculations and curves for a particular case. [See Abstract 1226 (1926).] AUTHOR.

1966. Lift Coefficient for Thin Elliptic Cylinder. L. Howarth. *Roy. Soc., Prov.* 149*A*. *pp.* 558–586, *April* 10, 1935.—For a range of values of the angle of incidence, the circulation round an infinitely long thin elliptic cylinder has been determined theoretically. The calculations fall into three classes according as the boundary layer is fully laminar, fully turbulent or contains both laminar and turbulent portions.

AUTHOR.

***1967. Measurement of Velocity of Vessels, Submarines or Aeroplanes by Compensated Thermoelectric Couples. A. Egal.** *Comptes Rendus*, 200, *pp.* 812–814, *March* 4, 1935.—Two holes in the same horizontal line and about 2 m. apart, are pierced in the hull of the vessel and connected by a tube of 150 mm. dia. In similar fashion a smaller tube, DD′, 1 m. × 20 mm., leads from and back to this tube. On DD′ is fixed the author's thermoelectric flowmeter, suitably modified [see Abstract 1843 (1934)]. As the boat travels, water flows through the tube at a velocity varying with that of the vessel. A similar arrangement, *mutatis mutandis*, applies to aeroplanes. Detailed diagrams are given. C. A. S.

1968. Optical Method for Measuring the Distribution of Velocity Gradients in a Two-Dimensional Flow. E. D. Alcock and C. L. Sadron. *Physics*, 6. *pp.* 92–95, *March*, 1935.—It is known that all colloidal suspensions and a large number of very viscous pure liquids show a considerable refraction when in motion. The laminar two-dimensional flow of a pure liquid along a solid boundary is considered. It is supposed that there is a constant gradient of velocity perpendicular to the boundary. The separation of the vibrations of the two components of polarised light through the liquid is given by $D = n_1 - n_2$. For any type of flow $D = \mu K (\partial u/\partial y - u/R)$. When the radius of curvature R is large, the above phenomenon gives a simple method of measuring the distribution of velocity gradients or of velocity without disturbing the flow. The problem is reduced to measuring the double refraction D and Maxwell's constant K. Application is made to flow between two infinite planes, in a diverging channel and between rotating cylinders. Experimental investigations of the boundary layer and turbulent distributions could be made by this method. G. F. P. T.

See also Abstracts 1916, 1917.

KINETIC THEORY OF MATTER.

1969. Magnetic Moments of Molecules by the Method of Molecular Rays. R. Schnurmann. *J. de Physique et le Radium*, 6. *pp.* 99–107, *March*, 1935.—The experiment of Stern and Gerlach in which molecular rays are employed is the most direct method for determining the spectroscopic fundamental state of paramagnetic molecules and their magnetic moment. The examples of O_2 and NO show that the experimental method of molecular rays together with quantitative measurement of the intensity gives a good verification of spectroscopic theory even in these cases which are complicated. Thus the agreement with theory is within about 4 % for O_2 and 4·7 % for NO. J. J. S.

1970. Brownian Motion in Hilbert Space. J. Métadier. *Comptes Rendus*, 200. *pp.* 807–809, *March* 4, 1935.—The connection is demonstrated between the wave-mechanics of the wave-function space proposed by J. L. Destouches [see Abstract 4057 (1934)] and the theory of Brownian motion. G. C. McV.

See also Abstracts 1950, 2132, 2185, 2231.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

1971. Light-Waves as Units of Length. W. E. Williams. *Nature,* 135. *pp.* 459–461, *March* 23, *and pp.* 496–497, *March* 30, 1935.—A critical review is given of all the determinations of primary standards of length in terms of wave-lengths of light, together with a comparison of the results obtained. The mean of the more recently determined values of the metre in terms of the wave-length of the cadmium red radiation in " normal " air is shown to be closely the same as that which was internationally accepted in the definition of the Ångstrom unit. It is pointed out that a considerable improvement in the precision of length measurements would be possible if a wave-length *in vacuo* were to be eventually accepted as the basis for the future definitions of the units of length. H. B.

***1972. Precision Cathetometer. C. Moon.** *Bureau of Standards, J. of Research,* 14. *pp.* 363–365, *March,* 1935.—A cathetometer which was built for the special purpose of measuring the length of single-layer inductance coils is described. The instrument is suitable for precise measurements of length by comparison with a standard scale. Two microscopes with micrometer eyepieces are carried on a vertical shaft which is supported by a self-aligning type of ball bearing at the bottom and a V-block type of bearing at the top. These bearings allow the shaft to turn easily on its axis with no tendency to bend the shaft and thus vary the distance between the microscopes. A brief discussion is given of the error caused by inaccurate focusing which was especially troublesome in measuring the length of inductances. AUTHOR.

MATHEMATICAL METHODS, THEORY OF MEASUREMENTS, UNITS AND DIMENSIONS.

1973. Constant Logarithmic Potential of Strata and Characteristic Integral Relations of the Ellipse. P. Dive. *Comptes Rendus,* 200. *pp.* 716–718, *Feb.* 25, 1935.—Strata considered are those contained between two closed curves which do not intersect and one of which is inside the other. An expression is obtained for the logarithmic potential of such a stratum and it is shown to be constant when limited by homothetic ellipses. The integral relation is also given and certain forms of it are difficult to obtain by pure geometrical means. R. S. R.

1974. Formulation of Experimental Laws and the Uncertainty in the Interpretation of Physical Phenomena. P. Vernotte. *Comptes Rendus,* 200. *pp.* 809–812, *March* 4, 1935.—It is pointed out that, since many mathematical functions can represent a given set of experimental data, no physical conclusion is valid which depends on the choice of a particular functional form for the mathematical representation. G. C. McV.

1975. χ-Test and Curve Fitting. W. E. Deming. *Am. Statist. Assoc., J.* 29. *pp:* 372–382, *Dec.,* 1934.—The χ-test was designed by Pearson as a criterion for testing a proposed frequency distribution. The fundamentals of curve fitting are critically examined. It is found that to each observed point there correspond a calculated point and an unknown true point. The calculated points lie on the fitted curve; the true points lie on an unknown true curve. The *distribution* of χ^2 is unaffected by the number of observed coordinates at any point; the *value* of χ^2 is affected by this number. The number of degrees of freedom, k is $n-p$, n denoting the number of points and p the number of independent adjustable parameters. By equating χ^2/k to unity, an estimate of the root mean square of unit weight is obtained. This estimate permits various formulæ fitted to the same data to be compared ; an example is given. J. S. G. T.

1976. Finite Probability Calculus. H. Reichenbach. *Zeits. f. Physik*, 93. 11–12. *pp*. 792–794, *Feb*. 26, 1935.—In a recent paper [see Abstract 103 (1935)] by H. Blume, certain statements are made concerning the work of the author which are based on a misunderstanding. Careful distinctions are drawn between two types of probability calculation, a formal and a comprehensive, and illustrations are added from geometry. It is shown that it is only a matter of taste whether finite or infinite series are used in the theory of probability, for the difficulties in the theory lie, not in the finiteness or otherwise of the series, but rather in the difference between observed and unobserved series terms ; the theory is of value to physical work only for those problems which are capable of solution. H. J. H. S.

1977. Least Squares and Linear Combination of Observations. A. C. Aitken. *Roy. Soc. Edinburgh, Proc.* 55. 4. *pp*. 42–48, 1935.—Reference is made to papers in which Sheppard considered the approximate representation of equidistant, equally weighted, and uncorrelated observations under certain assumptions and to the results he obtained. In this paper the problem is treated from a more general standpoint, extending it so that, (1) the data need not be equidistant, (2) they may be weighted and even correlated, and (3) the representation need not be restricted to one based on a set of values of a polynomial, but may be in terms of periodic exponential, or any arbitrary set of sufficiently designed functional values, provided only that they are linearly independent over the n values of x. The approach from the standpoint of least squares is first considered and some classical results given by way of illustration. The argument is then extended to data having correlated errors. Sheppard's assumptions are then taken and the results developed. Finally the uncorrelated case is discussed. R. S. R.

1978. Theory of Probability. *J. Math. Phys.* 14. *pp*. 1–35, *March*, 1935.—" Introductory Paper," by **D. J. Struik** (*pp*. 1–3).—Describes the scope of the subsequent papers and historical details relating to the theory of probability.

" Remarks on Causality and Probability," by **E. Hopf** (*pp*. 4–9).—The problems of the coin and die are dealt with. It is shown how the ideas of Caratheodory and v. Smoluchowski when combined lead to a satisfactory explanation of the classical probability phenomena while theorems on compound probabilities and on the frequency in sequences remain true when based on the above general notion.

" Probability of Position in a Canonical Ensemble," by **G. E. Uhlenbeck** (*pp*. 10–16).—Classical statistical mechanics is considered to be a limiting case of the quantum statistics and a special problem is considered. For a mass point on an outside force field the Schrödinger equation is given and for a canonical ensemble of these mass points the unnormalised probability density of position is stated. It is shown how this latter expression contains that derived from the Boltzmann-Gibbs statistical mechanics as a limiting case. Special cases also are treated.

"Random Functions," by **N. Wiener** (*pp*. 17–23).—A general statement is given first of the idea of random functions and its application to Brownian motion. The Einstein theory of Brownian motion shows that the latter is almost always continuous and subject to a condition of equicontinuity except for a set of cases, or what is equivalent, whose probability can be reduced to as small a value as is wanted. The theory of random functions is essentially a theory of integration in function space, and finally the latter is derived from the ordinary integration of a function of one variable over an interval of a line by process of mapping.

"Analytical Problems Relating to Probability," by **B. Jessen** (*pp*. 24–27).—The theory of measure and integration in a certain space of an enumerable number of dimensions has been used in many cases and it is developed here in analogy to the theory of the *n*-dimensional torus space. It is shown how the theory applies to a number of analytical problems.

"Principles of Probability in Natural Science," by **F. Bernstein** (*pp*. 28–35).—The following four cases are discussed: (1) probability of Mendelian heredity, (2) probability of composition of a Mendelian population, (3) probability of death as a function of age, and (4) probability of crossing-over and geometry of the chromosome. R. S. R.

***1979. New Trigonometrical Slide Rule.** *Engineer*, 159. *pp*. 300–301, *March* 22, 1935.—A development of the Thornton P.I.C. slide rule, incorporating a further application of the differential scale principle is described. Two new differential scales enable sine, tangent and the inverse functions to be read off directly. The theory of the scales is based upon the algebraic expansion of the various functions in power series. The sine and tangent differential scales become increasingly open towards their high-value ends. J. S. G. T.

See also Abstracts 1971, 1985, 2017, 2046, 2049, 2277.

MECHANICS, CLASSICAL.

1980. Liouville and Stäckel's Theorems for a Mechanical System. B. S. M. Rao. *Zeits. f. Physik*, 93. 5–6. *pp*. 320–328, *Jan*. 19, 1935.—Shows that if a mechanical system is integrable by Liouville's method it is also integrable by Stäckel's method, and that the converse is true for systems of two degrees of freedom. W. S. S.

See also Abstract 2004.

MECHANICS, QUANTUM.

1981. Groups of Waves Associated with Clouds of Electrons. G. Peretti. *Accad. Lincei, Atti*, 20. *pp*. 411–416, *Dec*. 2, 1934.—It is known that the concept of group velocity can be applied to groups of waves associated with generic physical phenomena, and that the motion of groups of the first, second or third orders can be characterised by the motion of a surface, line or point, respectively, where the phases of the waves are in agreement. The present paper considers from this point of view the group of waves associated with the motion of a cloud of electrons subjected to the action of a constant electric field. It is found that, whilst each electron moves in a parabola, whose convexity is turned towards the field, it may happen (for particular initial conditions) that the group of the second order may be characterised by a trajectory whose convexity is turned in the opposite direction. The characteristic point of the group describes therefore a path proper to a particle of positive mass rather than one of negative mass, a fact which recalls the phenomenon of the positive electron. A. J. McC.

1982. Harmonic Oscillator in Thermal Equilibrium. H. Ott. *Phys. Zeits.* 36. *pp.* 51–54, *Jan.* 15, 1935.—Gives a direct wave-mechanical proof of the result that if a harmonic oscillator is in thermal equilibrium, the chance that the oscillating particle is located at a distance ξ from the origin is determined by a Gauss error function of the form $e^{-k\xi^2}$. The result is used to calculate the effect of temperature on coherent X-ray scattering. W. S. S.

1983. Convergence of Certain Approximation Solutions of the "External" Equation of the Two-Centres Problem. E. A. Hylleraas. *Zeits. f. Physik*, 93. 9–10, *pp.* 582–588, *Feb.* 14, 1935.—The convergence of certain approximations given earlier by the author [see Abstract 337 (1932)] for the wave-equation of the ion of the hydrogen molecule is discussed and an objection raised by Jaffé is refuted. The expansion of the solutions according to a more rational system of functions is also sketched. H. L. B.

1984. Separation of Rotational Coordinates from the Schrödinger Equation for N Particles. J. O. Hirschfelder and E. Wigner. *Nat. Acad. Sci., Proc.* 21. *pp.* 113–119, *Feb.*, 1935.—The number of variables involved in quantum or classical equations of motion can be reduced by utilising the constants of motion of the system. For a set of N particles moving in a field-free space there are, for $N > 2$, six integrals corresponding to the laws of conservation of linear and of angular momentum. In this paper the coordinates of rotation and of translation of the total system are eliminated from the Schrödinger equation, and a new set of differential equations is obtained, involving only 3N–6 variables. Separation of the translation coordinates is effected by decomposing the total energy into the sum of the energy due to the motion of and relative to the centre of mass. Rotation is treated by the group theory; for every configuration a "standard position," which is the same for all configurations, is defined, the simplest results being obtained if the centre of gravity is in the origin of the coordinate system and the principal axis of inertia parallel to the coordinate axes. The Schrödinger equation is obtained after the elimination of the six integrals of motion. N. M. B.

1985. Relativistic Quantum Mechanics and Wave Geometry. Y. Mimura. *Hiroshima Journ. Sci.* 5. *pp.* 99–106, *Feb.*, 1935. *In English.*—A solution to the problem suggested by Schrödinger, that it may be necessary, in regard to microscopic space, to abandon the idea of "position" of an elementary particle or the notion of "geometry," is attempted by deducing the microscopic from the macroscopic metric on the correspondence-Schrödinger equation : Dirac equation : : macroscopic metric : microscopic metric. This leads to the conclusion, having a relativistic space-matter analogue, that microscopic space exists only when an elementary particle exists, and that where there is no particle no "geometry" exists. It is deduced, from a consideration of microscopic length $ds\psi$, that the eigenvalues of microscopic length are macroscopic length, and the eigenvalues of the quantum mechanical H atom model are the energy levels of the Bohr H atom model, and this suggests the correspondence–Bohr H atom model : quantum H atom model : : macroscopic length : microscopic length, whence the geometry based on $ds\psi$ in microscopic space is termed "wave geometry." Defining the mass m_0 of an elementary particle with reference to the principle of correspondence it is shown that m_0 is a universal constant, *i.e.*, the electron is a unit of mass in microscopic phenomena. Since the wave equation of a photon and the generalised Dirac equation are not fully known, the microscopic space based on the photon, and the generalised Riemannian-like microscopic space cannot yet be fully developed, though a possible treatment is suggested. Since on the present theory the geometries of microscopic and macroscopic space are not identical a final unified field theory cannot yet be arrived at. N. M. B.

1986. Resolution of Bond Eigenfunctions in Terms of a Linearly Independent Set. H. Eyring and H. Gershinowitz. *J. Chem. Phys.* 3. *pp.* 224–229, *April*, 1935.—By means of simple operators derived from the antisymmetrical configuration eigenfunctions a method is devised for obtaining the coefficients in the expansion of a bond eigenfunction in terms of a linearly independent set. This method eliminates any necessity of drawing diagrams and removes the unique advantage of the uncrossed set. It is applied to the determination of the coefficients of eigenfunctions expanded in terms of the Rumer (uncrossed) set for as many as six bonds. For three and four bonds crossed sets are given for which the process of resolving eigenfunctions is simpler than for the Rumer set. A convenient method of expansion in terms of the Rumer set is extended to include eigenfunctions of as many as six bonds of any multiplicity. AUTHORS.

1987. Quantum-Mechanical Treatment of Molecules by the Method of Spin Valence. G. W. Wheland. *J. Chem. Phys.* 3. *pp.* 230–240, *April*, 1935.—The method of spin valence, developed by Born, Heitler, Rumer and Weyl for the treatment of molecular systems, becomes completely equivalent to the Slater method if the bonding forces are considered to be exerted between individual orbitals, and not between entire atoms in definite spectroscopic states. This change in the point of view eliminates several difficulties which were formerly present in the method (*e.g.*, the obscuring of the directional properties of the valence bonds). The secular equation, for which a simplified derivation is given, is of quite a different form from the Slater equation, and the problem of its solution is considered in some detail. In addition to the rigorous methods, several approximate methods are given, of which two (applicable to unsaturated and aromatic hydrocarbons) do not require that the secular equation be set up at all. The method of spin valence is found to be more convenient than the Slater method for the treatment of systems of high multiplicity. Finally, the extension to cases of orbital, as well as spin degeneracy is briefly outlined. AUTHOR.

1988. Symmetry Properties and Identity of Similar Particles. E. E. Witmer and J. P. Vinti. *Phys. Rev.* 47. *pp.* 538–541, *April* 1, 1935.—It is demonstrated that in a system of N similar particles, the permissible wave functions are either symmetrical or antisymmetrical with respect to interchanges of the particles, if the following principles are assumed to be valid: (1) the interchange of two like particles produces no change in any measurable property of the system. In particular, if ψ is to be a permissible wave function, $\psi\bar{\psi}$ must be unaltered by such an interchange. (2) All the wave functions obtained from a given permissible wave function by permuting the similar particles are also permissible wave functions for the same eigenvalue. AUTHORS.

1989. Calculations of Atomic Wave Functions. Part III. Results for Be, Ca and Hg. D. R. Hartree and W. Hartree. *Roy. Soc., Proc.* 149. *pp.* 210–231, *April* 1, 1935.—In continuance of the plan, outlined in an earlier paper [see Abstract 965 (1934)] for making generally available the results of calculations of atomic wave functions by the method of the self-consistent field, results for the atoms Be, Ca and Hg both neutral and doubly ionised, are here presented. In calculating wave functions for the neutral atoms, the perturbation of the core by the two valency electrons has been taken into account as far as this is possible in the "self-consistent field" approximation; this perturbation is not large for Be and Ca, but is considerable for Hg on account of the sensitiveness of the $(5d)^{10}$ group to the atomic field. For neutral Hg, the self-consistent field is compared with the Thomas-Fermi field, and the differences between them are discussed. AUTHORS.

1990. Relationship between the Born-Infeld Field Equations and Dirac's Quantum Equation. K. Nikolsky. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 210–213, *Feb.* 1, 1935. *In German.*—Dirac's quantum equation for the electron may be derived from a variation principle. By making certain substitutions in this equation and subjecting it to variation the non-linear field equations are obtained. The double nature of the field is expressed in the difference in the operations for the velocity of an electron. There are only two universal constants in Dirac's theory of the electron, namely the radius of the electron and the fine-structure constant. The author shows that the spin of the electron is nothing else than the double nature of the field in the sense of Born and Infeld. [See following Abstract.] H. L. B.

1991. Electromagnetic Field of the Dirac Electron. K. Nikolsky. *Comptes Rendus,* 200. *pp.* 1086–1088, *March* 25, 1935.—It is shown that the non-linear system of equations comprised in Born and Infeld's electrodynamic theory [see Abstract 1875 (1934)] is derivable from Dirac's theory. [See preceding Abstract.] J. S. G. T.

1992. Deduction of the Fundamental Equations of Statistics. S. Flügge. *Zeits. f. Physik,* 93. 11–12. *pp.* 804–808, *Feb.* 26, 1935.—The author considers that the basis of the Bose-Fermi statistic, *viz.*, the idea of statistical probablity, is in many ways unsatisfactory, and proposes to substitute therefore the notion of the frequency of transitions between two states. J. S. G. T.

1993. Quantum Statistical Theory of Spontaneous Fluctuation. M. Ghosh. *Phil. Mag.* 19. *pp.* 694–708, *March,* 1935.—In 1923 Kar derived some important classical relations between different partial fluctuations. With the help of these, and from two partial fluctuations obtained independently by statistical methods, he obtained the expressions for all other fluctuations known. The author here generalises the partial relations of Kar both for the non-degenerate and the degenerate case, and calculates the energy fluctuation at constant volume and the density fluctuation at constant temperature, with the help of quantum statistics. From these two partial fluctuations, and with the help of the above generalised partial relations he is able to derive all the fluctuations yet known. H. L. B.

See also Abstracts 1907, 1970, 2088, 2089, 2131, 2132, 2219, 2253.

RELATIVITY AND ETHER.

1994. Clock Problem of Relativity. J. W. Campbell. *Phil. Mag.* 19. *pp.* 715–720, *March,* 1935.—In a particular case discussed by Eddington a body B projected from the earth returns to find that he has lived a shorter time than a body A which has remained on the earth undisturbed. The author shows that B may have been disturbed in such a way as to leave the earth and return to find that he had lived a *longer* time than A who remained on earth. It is shown that time is increased over some disturbed paths and that the explicit effect of disturbances themselves on Time is zero. The special case is considered where B is disturbed so as to follow a cometary orbit with perihelion distance equal to the perihelion distance of the earth and with longitude of perihelion sufficiently different from that of the earth so that the earth would not appreciably perturb B's motion on subsequent near approaches, and at some later approach it is again projected to the earth at a perihelion passage. The effects of the following four factors are considered: (1) sun's gravitational field, (2) earth's gravitational field, (3) the projecting disturbances on B, (4) the disturbances (molecular bombardments by the earth) on A. H. L. B.

1995. Law of Equivalence between Einsteinian and Newtonian Motions. T. Levi-Civita. *Accad. Lincei, Atti,* 20. *pp.* 398–403, *Dec.* 2, 1934.—Levi-Civita has shown how a correspondence can be obtained (to the second order of approximation) between the Einsteinian motion of a particle in a field of force of potential U with the Newtonian motion of a particle in a field of force of potential U_1, the times in the two motions being related in a certain way. He now gives a more complete correspondence in which the times in the two trajectories are the same. His new theorem of equivalence states that the Einsteinian trajectory of a particle under a force potential U coincides to the second order of approximation with the Newtonian trajectory under the force potential $U_1 = (1 + 4E_0/c^2)\,U + 3U^2/c^2$, where E_0 is the initial value of $(\frac{1}{2}V^2 - U)$ and c is the velocity of light. A. J. McC.

1996. Gauss' Theorem and the Concept of Mass in General Relativity. E. T. Whittaker. *Roy. Soc., Proc.* 149A. *pp.* 384–395, *April* 1, 1935.—The well-known theorem of Gauss on the Newtonian potential, viz., that the total flux of gravitational force through a simple closed surface is equal to $(-4\pi) \times$ the total gravitating mass contained within the surface, is extended to general relativity. In the extended theorem, the Newtonian concept of "gravitating mass" is naturally replaced by that of the energy-tensor, which does not in general consist solely of the "material" energy-tensor, and need not involve any matter at all. It is shown that in order to provide a simple physical interpretation of the formulæ obtained, a new concept must be introduced, to which the name "potential mass" is given. The electrostatical form of Gauss' theorem is also extended to general relativity. AUTHOR.

See also Abstracts 1990, 1991.

SOLUTION.

1997. Solubility of Silver Chloride by Electrometric Titration Method. A. S. Brown and D. A. MacInnes. *Am. Chem. Soc., J.* 57. *pp.* 459–465, *March,* 1935.—A method is described for carrying out electrometric precipitation titrations in which the uncertainty due to liquid junction potentials is reduced to a minimum. A new theoretical treatment of the data obtained during such titrations is discussed. The results may be represented upon a linear plot, the parameters of the line being the titre increment at the equivalence point and a function of the solubility of the precipitated salt. Accurate values of the solubility of silver chloride in a dilute potassium nitrate solution have been measured. AUTHORS.

See also Abstract 2194.

SURFACE TENSION AND COHESION.

See Abstract 1889.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 2069.

VISCOSITY, FRICTION AND LUBRICATION.

1998. Physical Properties and Structure of Glass. S. Erk. *Forsch. IngWes.* 6. *pp.* 33–39, *Jan.–Feb.*, 1935.—The work of a number of authors on the viscosity of glass at temperatures up to 1,400° C. and on the electrical resistance at temperatures up to 800° C. is summarised. It is shown that below a certain critical temperature the physical properties of glass depend on the initial thermal treatment but that above that temperature they are appreciably constant. It is suggested that glass may be regarded as a polymerised fluid; as the temperature falls, the degree of polymerisation increases whilst the velocity of polymerisation greatly decreases. Polymerised glasses are in an extremely stable state for crystallisation can only occur by disturbance of the existing molecular arrangement. H. J. H. S.

1999. Change of Viscosity of Paramagnetic Gases in Magnetic Field. M. Trautz and E. Fröschel. *Ann. d. Physik*, 22. 3. *pp.* 223–246, *March*, 1935.—The gases O_2 and NO were tested by a transpiration method for change of viscosity in magnetic fields and at different temperatures and pressures. The authors conclude that in these gases the effect $-\Delta\eta/\eta$ is independent of the direction of the field, but increases with the field to a maximum at a comparatively low field intensity. The effect diminishes with fall of temperature, and is dependent on het pressure of the gas. The largest values found for the effect were under 0·5 %. G. E. A.

See also Abstracts 1913, 1957.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***2000. Trends in Design of Astronomical Telescopes and Accessories. G. W. Moffitt.** *J.O.S.A.* 25. *pp.* 71–79, *March*, 1935.—The paper described the results of detailed research at Yerkes Observatory in connection with the plans for McDonald Observatory and its 82-inch reflector. The object has been the maximum adaptability, with if possible as great effectiveness for special fields as if specially designed for them. For the main mirror F/4 is adopted. For direct photography the camera will normally be in the prime focus, though the Newtonian system is also provided for. An account is given of the control, focussing, and guiding arrangements in prime focus. The Cassegrain arrangement has focal length 95 feet, giving F/14. The equivalent length of the Coudé system will be 160 feet (F/24). Full details and plans of the Cassegrain camera are appended. The driving mechanism consists of an electric motor locked in step with the oscillations of a tuned electrical circuit; a modern feature is changeable rate and provision of drive in declination, both aimed at refraction and flexure effects. For coating the mirrors a new chromium-aluminium process by Williams is being tried. Three spectrographs are in preparation. T. L. M.

***2001. Guthnick Photoelectric Stellar Photometer. E. J. Meyer.** *Zeits. f. Instrumentenk*, 55. *pp.* 111–116, *March*, 1935.—A brief historical account of stellar photometry is given. This is followed by a description of the constructional details of a photoelectric stellar photometer due to Guthnick, with an outline of the method of reduction of its indications. D. H. F.

***2002. Photographic Moonlight Recorder. C. B. Williams and G. A. Emery.** *Journ. Sci. Instruments*, 12. *pp.* 111–115, *April*, 1935.—The paper describes a photographic recorder for moonlight. It consists of a cylindrical lens mounted on a light-tight drum which rotates at a speed of one revolution in 24 hours and 50 min., which is the average time of the moon's apparent rotation round the earth. The axis of the drum is set pointing to the pole star and by means of a timing disc the drum is set each afternoon so that the lens follows the position of the moon. Inside the rotating drum is a fixed drum on the outer surface of which is a strip of photographic bromide paper. On this the line image of the moon, produced by the cylindrical lens, is focused. The darkening of the bromide paper gives an indication both of the duration and of the intensity of the moonlight. AUTHORS.

See also Abstract 2058.

COSMOGONY.

See Abstracts 1960, 2017, 2146.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

2003. Dynamics of Star-Clusters. O. Heckmann and H. Strassl. *Göttingen Nachrichten*, 1. 7. *Fachgruppe* 2. *pp.* 91–106, 1934.—The dynamics of a star-cluster are worked out under the assumptions that the system, although in a fluctuating condition, possesses only a small number of stars with the velocity of escape and that the potential field in the neighbourhood of a certain point is constant over short intervals of time. The cluster is ellipsoidal and the point considered is near the plane of symmetry. The distribution function of the stars can then be found in the neighbourhood of the point. The theory is applicable to that part of the galactic system which is near the sun. G. C. McV.

2004. Gibbs-Hertz Adiabatic Invariant in the Restricted Problem of Three Bodies. G. Lampariello. *Accad. Lincei, Atti,* 20. *pp.* 416–423, *Dec.* 2, 1934.—A dynamical system, whose Hamiltonian function H is independent of the time, admits the energy integral $H = E$ and this equation represents in phase-space a family of surfaces Σ. It is known that, if a Σ is closed, the volume enclosed by it is invariant for adiabatic variations of the parameters on which H depends. It is the Gibbs-Hertz adiabatic invariant, and the present paper evaluates it in the special case of the restricted problem of three bodies, that is, for the motion of a particle under the Newtonian attraction of two heavy masses which are rotating uniformly round their centre of gravity. As a particular case one can deduce Levi-Cività's theorem which expresses the invariance of the product of the total mass and the major axis of the orbit in the two-body problem with variable mass. A. J. McC.

See also Abstract 2008.

NEBULÆ.

2005. Nebulium Emission in Planetary Nebulæ. S. Chandrasekhar. *Zeits. f. Astrophysik,* 10. *pp.* 36–39, *March* 13, 1935. *In English.*—The radiative equilibrium of a planetary nebula in the field of the nebulium radiation is considered and it is shown that the flux and the density of radiation in the nebulium lines vary from the inner to the outer boundary of a planetary nebula in exactly the same way as in the field of the Lyman-α radiation. It is further shown that the " mean " frequency v_c of the ultra-violet radiation has to be obtained by averaging the frequencies beyond the head of the Lyman series weighting each frequency by the number of quanta of that frequency in the incident star light. AUTHOR.

2006. Angular Rotations of Spiral Nebulæ. E. Hubble. *Mt. Wilson Observat., Contrib. No.* 514. *Astrophys. J.* 81. *pp.* 334–335, *May,* 1935.—Measures of photographs of M81, M51, M33, and M101, made with the 60-in. reflector over about 23 years in all cases show no rotational term exceeding the uncertainty of the measures. Systematic errors are checked by the inclusion of known proper motion stars. Some pairs of plates have been remeasured by Baade and Nicholson with similar results. [See following Abstract.] T. L. M.

2007. Internal Motions in Spiral Nebulæ. A. van Maanen. *Mt. Wilson Observat., Contrib. No.* 515. *Astrophys. J.* 81. *pp.* 336–337, *May,* 1935.—Plates of M33 and M74 with the 100-in. telescope at an interval of nine years show a rotation in the direction previously found by the writer. The amount of motion is however reduced; the same is found for plates taken in the 80-ft. focus of the 60-in. This result, with those of Hubble and others [see preceding Abstract] make it desirable to view the motions with reserve. Work is proceeding towards elimination of some possible systematic influences. T. L. M.

See also Abstracts 1960, 2011.

PLANETS.

2008. Theory of Saturn's Rings. C. G. Pendse. *Roy. Soc., Phil. Trans.* 234*A*. *pp*. 145–176, *March* 6, 1935.—The stability of the steady motion of *n* particles of equal mass about the centre of a homogeneous sphere is discussed on the assumption that the system is " isolated " and completely Newtonian. In the steady state the particles are assumed to form a regular polygon; this state is dynamically possible without any approximations if the angular velocity is suitably chosen. The system is then assumed to undergo a slight disturbance in the initial plane of the system. Equations are derived for the disturbed motion of the typical particle to the first order of small quantities. After a transformation of variables, 2*n* second order linear differential equations with constant coefficients are derived, in independent pairs. The *n* stability equations must all have real roots; it is shown that the steady motion is now unstable for 2 to 6 particles and that there must be a stability lower limit to *n* but this cannot be computed. Maxwell's limit for stability is investigated; the limit here obtained differs appreciably. The ring divisions and the rôle of the satellites remain insoluble; Goldsbrough's method is shown to be unsound here. T. L. M.

See Abstract 2002.

STARS.

2009. Apsidal Motion in α Virginis. W. J. Luyten and E. Ebbighausen. *Astrophys. J.* 81. *pp*. 305–311, *May*, 1935.—The new orbit of the spectroscopic binary α Virginis derived by Struve and Ebbighausen has been compared with that of Baker, and a period for the apsidal revolution of 114 years (about ten thousand times the period of orbital revolution) derived. Calculating the probable dimensions of the stars, and using Struve's observations on the velocities of axial rotation, the conclusion is reached that the stars have broken away from tidal control and that the brighter component, at least, rotates considerably faster than it revolves. Rough estimates for the density concentration are deduced by applying Russell's and Walter's formulæ. AUTHORS.

2010. Velocity-Curve of 27 Canis Majoris. O. Struve. *Astrophys, J.* 81. *pp*. 345–347, *May*, 1935.—The long-period velocity-curve of this spectrum variable does not exactly repeat itself in successive minima and cannot be attributed to orbital motion. Superposed over this curve is a variation having a period of approximately 118 days and a range of 50 km./sec. The total observed range in velocity is about 250 km./sec. AUTHOR.

2011. Radiation Field in a Hydrogen Nebular Envelope. B. P. Gerasimovič. *Zeits. f. Astrophysik*, 10. *pp*. 1–14, *March* 13, 1935. *In English*.—This paper deals with the hydrogen nebular envelopes surrounding some early stars. It is supposed that the nebular layers are stratified in parallel planes, the atoms possess three quantum states only (the fourth being " at the infinity ") and that in the first approximation the ionisations from higher states may be neglected. The analytical expressions for $L\alpha$ and $L\beta$ intensities as well as for relative concentrations n_2 and n_3 are derived. It appears that $L\beta$ radiation and n_3 decrease exponentially with the optical distance from the star, while $L\alpha$ radiation and n_2 change linearly. The validity of Zanstra's approximative treatment of the nebular problem is proved and the accumulation of atoms in the second state is shown. Numerical solutions for $H\alpha$ intensity inside the envelope are made and it is shown that for sufficiently large optical thickness the external nebular layers contribute to absorption. This result is of importance for understanding the nature of central " reversals " in bright lines and of dark markings on the solar disc. Total emission in $H\alpha$ is calculated for Be stars and favourably compared with the data of observations; the agreement seems to be rather encouraging for the present theory. AUTHOR.

2012. Spectrum of γ Cassiopeiae. J. F. Heard. *Astrophys. J.* 81. *pp.* 341–344, *May*, 1935.—Spectrograms of the bright-line star γ Cassiopeiae taken recently with prism and grating instruments have been examined and compared with spectrograms of the same star taken previously with the same instruments. A new list of wave-lengths and identifications of emission lines is given for the visual region. Some unusual changes in the emission spectrum during 1934 are described. AUTHOR.

2013. Peculiar Spectroscopic Phenomenon in the Algol System. W. W. Morgan. *Astrophys. J.* 81. *pp.* 348–350, *May*, 1935.—The line Mg II 4481 in the spectrum of Algol is double at and in the vicinity of primary light minimum. The relative velocity of the two components, which is probably constant over the observed time, is about 60 km./sec. The individual velocities of the two components are constant after orbital motion has been eliminated. In addition to λ 4481, Fe II 4549 is also almost certainly double. These are the two strongest lines in the observed range, with the exception of the broad hydrogen lines. It is probable that the doubling is apparent only and that it is due in some way to the effect of the secondary component on the contours of the lines of the primary. AUTHOR.

2014. Central Density of a Star. J. Meurers. *Zeits. f. Astrophysik*, 10. *pp.* 56–66, *March* 13, 1935.—Two functions $H\ (r)$ and $\eta\ (r)$ are defined by $L(r)/M(r) = \eta(r)\cdot L/M$ and $L(r) = 4\pi\, r_2\, H(r)$. Their relation to the variation of density and their values at the centre of the stars are discussed. A relation is thus derived between their central values for any star and L/M for the same star. The assumptions made are defined; they permit of an estimation of the central density and this is compared with the observational data and the standard models. T. L. M.

2015. Variable Stars in Orion Nebula. A. Brun. *Comptes Rendus*, 200. *pp.* 901–903, *March* 11, 1935.—The author has charted all known variables in the region, 103 in number, from all sources including new photographs and visual observations, which have yielded 10 new variables. There is a close concentration in a rough rectangle, about 1° in R.A. by 2° in Dec., in which about 1/12 of the stars are variable. This suggests a connection with M42, M43, and NGC1977, in which case the stars are dwarfs of absolute magnitude $+ 7$ to $+ 9$. Most appear irregular, U Gem and R CrB types. T. L. M.

2016. Partial List of c Stars of Classes B and A. P. W. Merrill. *Mt. Wilson Observat., Contrib. No.* 512. *Astrophys. J.* 81. *pp.* 351–355, *May*, 1935.—A table is given of 95 c stars of classes B and A, most of which have been either discovered or confirmed by observations with slit spectrographs at Mount Wilson. The average absolute magnitude is thought to be about $- 5{\cdot}0$. The number of stars having hydrogen emission is noteworthy. AUTHOR.

2017. Deviation of Stellar Distribution from the Laws of Chance. T. E. Sterne. *Harvard Coll. Obs., Circ. No.* 396 [14 *pp.*] 1934.—In star counts on photographic plates where the number of stars in each small square of a *reseau* and within fixed magnitude limits is counted, a number-pattern of low probability indicates a probability of a real departure from random distribution. In the first method proposed, the squares are entered + or − as they contain more or fewer stars than the average. The criterion is the number of associations of the same sign in adjoining squares. In the second method the actual number of stars in the square is plotted against the average of the numbers in the four touching squares or some of them; in the absence of clustering, obscuration, or galactic concentration, the correlation derived should differ from zero by a mere sampling fluctuation. A very good value of the probability is easily derived. Numerous examples, covering high and low galactic latitudes, presence of obscuring matter, and the extreme case of globular clustering, are given. The significance of discrepancies between observed and expected standard deviations is discussed, as well as the comparison with the Poisson distribution. T. L. M.

See also Abstracts **2001**, **2003**, **2025**, **2032**.

SUN.

2018. Wing Profiles of Strong Fraunhofer Lines. M. Minnaert. *Zeits. f. Astrophysik,* 10. *pp.* 40–51, *March* 13, 1935.—The Pannekoek theory is amplified by taking into consideration the inclination of the rays in their passage through the solar atmosphere. The resulting distribution of intensity in the wings of strong lines is computed with as much precision as possible, and simple expressions obtained to represent this distribution with sufficient accuracy. It thus becomes possible to control and amplify the measurements of the outer parts of the lines. In a number of cases the equivalent width and the form of the wings are found and compared; it appears that the former value is usually measured rather smaller than is predicted by the theory from the latter. T. L. M.

2019. Chromospheric Emission in the Wings of H and K. A. D. Thackeray. *Mt. Wilson Observat., Contrib. No.* 516. *Astrophys. J.* 81. *pp.* 338–340, *May,* 1935.—Certain lines near the centres of the H and K Fraunhofer lines appearing in emission near the solar limb extend abnormally far into the disc, as noted by Evershed, in some cases reappearing in absorption at the centre. The phenomenon is explained as a lack of radiation to be absorbed, the atoms being able to reach the upper state prior to emission by absorption of other wave-lengths outside H and K. Two lines are identified as due to Nd^+ and Ce^+, indicating that these atoms emit and absorb mainly above the layers in which Ca^+ absorption takes place. AUTHOR.

2020. Radial Limitation of Sun's Magnetic Field. V. C. A. Ferraro. *Roy. Astron. Soc., M.N.* 95. *pp.* 280–289, *Jan.,* 1935.—Chapman's theory of the radial limitation of the solar magnetic field has met many difficulties; the most serious the high value of the mean free path required; with recent values the drift currents which he employed would be too feeble. The author therefore examines the alternative proposal that eastward electric currents may be set up by a motion of the sun's atmosphere from the poles to the equator across the radial component of the sun's magnetic field, thus producing the radial limitation. A suggested mechanism is the observed variation of the mean latitude of sunspots during the cycle; alternative causes of a meridional circulation may exist. T. L. M.

GEOPHYSICS.

GEODESY.

2021. Determination of the Geoid on the Basis of Gravity Observations. B. Numerov. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 17–25, *Jan.* 1, 1935. *In English.*—The author, referring to the difficulty of reducing observations made on the actual surface of the earth to the level surface, discusses the possibility of applying a suggestion made by Brillouin, that a potential surface running above the ocean and the continents should be used as the geoid. W. A. R.

2022. Polar Drift Force. L. Grabowski. *Gerlands Beitr. z. Geophys.* **43. 4.** *pp.* **346–352, 1935.**—It is pointed out that Ertel refers to b_φ and not the differential quotient $(\delta b/\delta n)$ of the polar drift force with height, and errors arise in assuming that the term $g_o\left[\frac{\psi_o - \phi_o}{a} + \left(\frac{\delta(\psi - \phi)}{\delta n}\right)_o\right]$ is negligible. Ertel's justification of his equation is examined and the errors arising from the assumptions in the derivation of the equations are explained in detail. If it be assumed, as Milankovitch does, that the known external gravity potential ought also to apply within the earth's crust, then for the polar drift force on an element of mass $d\mu$, the equation is $d\mathrm{H} = (z_s/r_o)\, d\mu\, (g_v - g_a) \sin 2\phi$. Milankovitch has a factor $\frac{1}{2}$ on the right hand side. It is shown how this error arises from confusing the terms $\frac{\delta}{\delta y}\left(\frac{\delta w}{\delta x}\right)$ and $-\frac{\delta}{\delta r}\left(\frac{\delta w}{r\delta\phi}\right)$ and the omission of one term in the potential expression. This term can be omitted only for a homogeneous or concentric layered sphere. [See Abstract 1053 (1935).] R. S. R.

GEOPHYSICS, APPLIED.

***2023. Gravimetric Process of Geophysical Prospecting. A. Graf.** *A.T.M.* 4. *T*19–20, *Feb.*, 1935.—Gravimetric methods of geophysical prospecting are especially valuable in exploring oil-deposits, which usually occur in strongly folded strata and sometimes in the neighbourhood of salt domes. There are two methods, one based on pendulum observations and the other on the use of a torsion balance. As in other papers of this series, the modern apparatus is described and illustrated; accuracy, technique and field processes are described. [See also Abstract 1524 (1935).] W. A. R.

HYDROSPHERE, PHYSICS OF THE.

2024. Penetration of the Red, Green and Violet Components of Daylight into Atlantic Waters. R. H. Oster and G. L. Clarke. *J.O.S.A.* 25. *pp.* 84–91, *March*, 1935.—Photoelectric measurements of the penetration of the red, green and violet components of daylight into the sea were made in the Sargasso Sea, in the Gulf of Maine and in coastal areas near Woods Hole. A comparison was also made with observations made previously in the blue region. The same method and apparatus

were used as before with the addition of two vacuum potassium (unsensitised) photocells and two sets of colour filters. The observations are summarised in a table and diagrams show the percentage of surface light reaching various depths. The penetration of the different colours in the various areas is discussed and the results compared with those obtained elsewhere by others. The areas have been arranged in order of decreasing transparency and range from the Gulf Stream to Woods Hole Harbour.
R. S. R.

See also Abstract 1948.

METEOROLOGY.

2025. Effect of Stratosphere Temperature on the Ozone Spectrum. D. Barbier, D. Chalonge, E. Vassy and C. Fabry. *Comptes Rendus*, 200. *pp.* 1063–1066, *March* 18, 1935.—The ultra-violet absorption spectrum of O_3 is affected by temperature, and about 70 % of the atmospheric O_3 is in a region (below 30 km.) at about − 60° C. [see Abstracts 3211, 4478 and 4569 (1934)]. The absorption spectrum of the atmospheric O_3 is here compared with that of the same amount of laboratory O_3 at 15° C., the same (objective prism) instrument being used for both. The optical density a_λ of the atmospheric O_3 is deduced from that of the atmosphere as determined from observations of the spectrum of Vega at various altitudes [see Abstract 1497 (1935)]. The absorption coefficient K_λ (optical density of 1 cm.) of O_3 at 15° C. is obtained by comparison of the continuum of a distant H_2 tube taken with and without a column of ozonised oxygen between tube and spectrograph. Plotted against λ (< 3400 Å) both a_λ and K_λ show alternate maxima and minima and a general increase with decreasing λ, the general trend being the same for both, but the minima being deeper for a_λ on account of the lower temperature. The relative advantages of the spectra of the sun and a bright star in the studies of atmospheric absorption are discussed in a note added by C. Fabry.
W. J.

2026. Quarterly Forecasts of Sea and Air Temperatures. G. F. McEwen. *Monthly Weather Rev.* 62. *pp.* 361–363, *Oct.*, 1934.—In order to forecast temperatures some months in advance, it seems reasonable to assume the existence of factors which influence the temperature trend. Past temperatures may be assumed as a composite index of these factors. Irregularities in these are removed by " smoothing "; thereafter by projecting these smoothed values a few months in advance and correcting for seasonal variations, an empirical forecast may be obtained. Such a method has been applied in the present paper to observations extending over a period of 20 years in Southern California. As a result good agreement has been found between predicted and actually observed temperatures both for sea and air. Also, in the author's opinion, these predications are considered to be of sufficient reliability to be useful economically in the region considered. Tables and diagrams illustrate the text.
A. E. M. G.

2027. Energy Density of the Horizontal Stream as a Measure of Eddy Motion. J. Grunow. *Gerlands Beitr. z. Geophys.* 43. 4. *pp.* 353–358, 1935.—The author first discusses the formulæ hitherto used in characterising eddy motion in the atmosphere and points out that these

do not give sufficient information either about the turbulence or about the gusts of the horizontal component of the wind to enable an evaluation of atmospheric turbulence as a meteorological factor to be obtained. He thereafter shows that the energy density of the horizontal stream may be used as a measure of eddy motion. The equation arrived at gives the energy density of the turbulent wind as equal to the sum of the energy densities of the mean wind and of the turbulence. At the same it gives information concerning the distribution of velocity in the single pulsations.
A. E. M. G.

2028. Ice-Age Theories. W. Köppen. *Gerlands Beitr. z. Geophys.* 43. 4. *pp.* 379–387, 1935.—The author gives a summary of his theory based essentially on alleged wanderings of the continents and poles, referring to recent work in support of it [see Abstract 3606 (1934)], and a brief one of Simpson's theory [see Abstract 4481 (1934)], based on variation in solar irradiation. C. A. S.

2029. Observations of Night Sky Luminescence by an Extinction Method. N. Dobrotin, I. Frank and P. Čerenkov. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 110–117, *Jan.* 21, 1935. *In English.*—Observations of the auroral green line 5577·3 Å in the light of the night sky have been made by the extinction method of Brumberg and Wawilow [see Abstract 4989 (1934)] using Rayleigh's auroral filter. It is found that the ratio of the intensity of the green line to the total intensity of the sky light varies from 4 % at the beginning of the night to 12 % at midnight. The absolute brightness of sky luminescence near the Pole star is found to be $1 \cdot 5 \times 10^{-8}$ candle per cm.^{2}, giving for the intensity of the green line at the zenith at maximum brightness a value of $3 \cdot 3 \times 10^{-9}$ candle per cm^2. Evidence is brought forward against McLennan's view that the variation of intensity of the green line is due to quenching by visible light. [See following Abstract.] C. B. A.

2030. Intensity Variation of the Auroral Green Line in the Night Sky. I. Chvostikov and A. Lebedev. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 118–124, *Jan.* 21, 1935. *In English.*—Photometric observations of the auroral green line by the Wawilow method using a monochromator instead of a filter were made in connection with the Complex Elbrus Scientific Expedition. In the course of the night the intensity rises sharply to a maximum, at about 1 a.m., when it is 2·8 times the initial value (10·40 p.m.), and then falls off more slowly. No intensity variation is observed during twilight. This disproves McLennan's theory of the effect. An alternative mechanism, based on the formation of metastable O atoms, is proposed. [See preceding Abstract.] C. B. A.

2031. Annual Variation of Night Sky Spectrum. J. Cabannes and J. Dufay. *Comptes Rendus,* 200. *pp.* 878–880, *March* 11, 1935.—The spectrograph now used by the authors [see Abstract 1527 (1934)] gives in about six hours a spectrum of the Northern night sky sufficiently dense for microphotometric separation of line intensities from the continuous spectrum. 68 spectrograms covering fourteen months show a parallel variation, apparently annual, in the line 4173 and the 4420 group; the variations are about threefold and exceed the erratic changes from night to night quite considerably. Maxima occur in March and August. A minimum in May is less intense than that in January. The curve runs parallel to that of auroræ frequency, is similar to that of general night-sky brilliance (with a difference possible due to greater intensity of the continuous spectrum in summer), and is comparable with Rayleigh's observations on the 5577 green line. T. L. M.

2032. Götz Inversion of Intensity-Ratio in Zenith-Scattered Sunlight. S. Chapman. *Roy. Soc., Phil., Trans.* 234*A*. *pp.* 205–230, *March* 8, 1935.—Formulæ are given for the intensity of zenith-scattered sunlight at different altitudes of the sun, for a wave-length in the ozone absorption band. These formulæ refer to special ozone-distributions, in an atmosphere on either a plane or a spherical earth. It is shown that in most cases, though not all, the ratio of the zenith-light, for two wave-lengths, has a minimum when the sun is low, thus agreeing with observation, but disagreeing with a supposed proof to the contrary, given by Pekeris. Numerical illustrations of the formulæ are given and briefly discussed. [*See also* Abstracts 2808 and 3619 (1934).] AUTHOR.

***2033. International Comparison of Standard Barometers. S. P. Fergusson.** *Monthly Weather Rev.* 62. *pp.* 364–365, *Oct.*, 1934.—The present paper deals with comparisons made early in 1933 between the various standard barometers in use in America. These barometers included four instruments at Blue Hill, three at the Geographical Institute, three at the Weather Bureau, and one at Toronto. The Blue Hill Standard of 1892 (Hicks No. 1019) was first compared with the other three instruments there, then with the others above mentioned in succession and again with those at Blue Hill. A summary of the comparisons is given in tabular form, and the differences observed discussed. The paper also contains a summary regarding two new primary standard barometers, (1) the new British Standard and (2) the new instrument of the Bureau of Standards. A. E. M. G.

See also Abstracts 2047, 2152.

SEISMOLOGY.

2034. Analysis of Seismograms. G. Demetrescu. *Comptes Rendus*, 200. *pp.* 850–851, *March* 4, 1935.—If a seismogram shows some oscillations of constant period and an amplitude varying exponentially they are due to an earth movement expressed by $x = B\, e^{at}\, sinwt$, where B and a are constants and the period $r = 2\pi/w$. A method is explained by which the components of the seismic wave may be determined. R. S. R.

2035. Propagation of Rayleigh Waves in Heterogeneous Media. C. L. Pekeris. *Physics*, 6. *pp.* 133–138, *April*, 1935.—A method is given for obtaining a power series expansion in the wave-length for the Rayleigh wave velocity in a half-space whose density ρ and elastic constants λ and μ are functions of depth. This is followed by a discussion of the Rayleigh wave problem in media where $\lambda = \mu$ and $\mu(z)$ and $\rho(z)$ are special cases of the type $(\rho/\rho_0) = (\mu/\mu_0) = A \cosh^2 (a + \beta z)$. AUTHOR.

2036. Time and Amplitude Relations in Seismology. H. Jeffreys. *Phys. Soc., Proc.* 47. *pp.* 455–458; *Disc.*, 459, *May* 1, 1935.—The paper deals with certain anomalies in the amplitudes of the waves observed in near earthquakes, and their relation to the method of transmission across interfaces. It is suggested that amplitude-observations in seismic prospecting may help to solve these theoretical problems. A rediscussion of the time relations shows that these are so closely related to the structure immediately below the observing station that the form of the interfaces produces no other appreciable effect. AUTHOR.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2037. Phase of the Diurnal Component of the Terrestrial Electric Potential Gradient. R. Guizonnier. *Comptes Rendus,* 200. *pp.* 852–853, *March* 4, 1935.—From an analysis of mean hourly values of all available data the observatories have been arranged in three groups: (A) maximum diurnal component at midday or a few hours later, (B) maximum at midnight, and (C) maxima at midday and midnight. Those in class C belong in winter to A but in summer some belong to B. It is considered that local time must be dealt with when studying the phase of the diurnal component. The variable effect is attributed to the sun's influence on the height of the ionosphere at the E- and F-layers, but further information is required to confirm it. R. S. R.

2038. Continuous Observations of the Rate of Production of Small Ions in the Atmosphere. A. R. Hogg. *Gerlands Beitr. z. Geophys.* 43, 4. *pp.* 359–378, 1935.—This investigation deals with a method employed to obtain the diurnal variation of *q*, the rate of ionisation in the free air at the Commonwealth Solar Observatory, Canberra. Various corrections are dealt with at length and the results obtained are compared with those to be expected from observations of the mean life and concentration of small ions. The results of hourly observations over a period of forty days show a simple variation of *q* with a maximum at 17 hours G.M.T. The possible existence of a "world wave" of *q* is discussed. The average value of *q* in these observations is 20 I the bulk of the ionisation being due to radioactive matter in the air. The average value of the mean life of the small ions is 62 seconds. The influence of wind strength on the rate of ionisation is briefly noted. AUTHOR.

***2039. Measurement of Atmospheric Ion Spectrum. H. Grieger** *Zeits. f. Instrumentenk,* 55. *pp.* 116–122, *March,* 1935.—Apparatus is described by means of which the spectrum of the electrical carriers of the free atmosphere can be measured by the charge method from the limit of conductivity up to $0\cdot0045$ cm^2 s^{-1} V^{-1}. At the entrance to the condenser electric field disturbances are avoided by the use of a Swann screening device. The lower end of the condenser is furnished with a Becker type of screen in order that the electric field shall be as well defined as possible and in order not to disturb the air current. The apparatus has special earthing and standardising arrangements which can be operated by hand or by means of an electric relay. The dimensions of the apparatus are so chosen that photographic registration of the results can be effected using a Lutz type of single-string electrometer. Comparison is made between the new condenser and that of Kähler and this leads to a discussion of the lowest permissible air-flow velocity. For accurate results where the experiments extend over long times, control of the air flow is necessary. A. W.

2040. Mechanism of High Velocity of Propagation of Lightning Discharges. A. M. Cravath and L. B. Loeb. *Physics,* 6. *pp.* 125–127, *April,* 1935.—Observations by Schonland and Collens with Boys' camera show that the luminous tip of the leader stroke of the lightning discharge advances with a high velocity sometimes exceeding 3×10^9 cm. per sec. From the fact that electrons travelling 10^9 cm. per sec. produce about 6,000 new electrons per cm. of actual path and that 6,000 new electrons per cm. in the direction of the field (i.e., $\alpha = 6{,}000$) requires 4×10^6 volts per cm. shows that to give the electrons a velocity in the direction of the field of 10^9 cm. per sec. would require a field exceeding 4×10^6 V per cm. even at the tip of the stroke. The fields, and therefore the electron velocities, are certainly far less than this value. Accordingly the velocity of the tip greatly exceeds the velocity of the electrons in the tip. It is possible to account for this velocity as follows: Calculations based on justified assumptions concerning the conditions known to exist in a lightning stroke show that if the field just ahead of the tip averages 10^5 V per cm. for about 1 cm., ionisation by collision by the electrons present in the gas before the stroke would be great enough to advance the tip at the observed rate. Such a field is found not too high to be consistent with the low conductivity of the leader path. In this way a propagation of the leader stroke of a velocity many times higher than the velocity of the electrons can be attained. AUTHORS.

2041. Diurnal Variation of Magnetic Disturbance in High Latitudes. J. M. Stagg. *Roy. Soc., Proc.* 149A. *pp.* 298–311, *April* 1, 1935.—Certain aspects of irregular magnetic disturbance are investigated by means of data from ten observatories in moderate and high latitudes in both hemispheres. The diurnal variation in disturbance, D, is controlled by local time over the range from 55° magnetic latitude, ϕ_m, to the magnetic axis pole. Below 70°, D is governed by a 24-hr. wave with an evening maximum which becomes later as ϕ_m increases till it falls at midnight at 70°. Above 80°, D has a forenoon maximum, and the transition from summer to winter is accompanied by a change of form, and D then has a maximum in the late evening as well as in the forenoon. In the transition zone, 70° to 80°, the form of D depends entirely on the season and on the amount of the general disturbance. On the equatorial side of the transition zone, *ca.* $\phi_m = 70°$, general disturbance probably reaches greater proportions than elsewhere on the earth. It is pointed out that the region of $\phi_m > 78°$, where the disturbance field undergoes such radical change, is also unique in its summer and winter receipt of direct solar radiation. G. E. A.

See also Abstract 2031.

RADIOACTIVITY.

2042. Period of Radium. Ellen Gleditsch and E. Föyn. *Am. J. Sci.* 29. *pp.* 253–259, *March,* 1935.—The paper gives the results of six determinations of the decay constant of *Ra* by observing the growth of *Ra* in ionium solutions prepared from samples of cleveite, broeggerite and uraninite. The results with the two latter minerals agree closely with previous results [see Abstract 549 (1933)] but the cleveite values are slightly different and reasons for this are put forward. W. E. P.

2043. Mathematical Expression of Bragg Curves for α-Particles from Natural Radioactive Bodies. M. Francis. *J. de Physique et le Radium,* 6. *pp.* 108–113, *March,* 1935.—Ionisation curves of α-rays which cannot be determined experimentally can be deduced from the curves of other substances previously studied. It is not possible to express these curves in all their extent by simple mathematical expressions, but on dividing the curves into two parts each part can be represented separately by a somewhat simple expression with satisfactory concordance. The Bragg curve of *U* is used to explain the method. J. J. S.

2044. Investigation of Straggling and of the Differential Ionisation Produced by Single α-Particles from Polonium in Air. H. Schulze. *Zeits. f. Physik,* 94. 1-2. *pp.* 104–133, *March* 12, 1935.—The differential ionisation along short lengths of the track of a single α-particle from polonium is examined with a Zipprich proportional amplifier and a Hoffmann duant electrometer. Using a guard-ring condenser, measurements of the ionisation along track lengths of 0·3 mm. show a Gaussian distribution in agreement with the results of Briggs. The ionisation-range curve rises to a maximum 5·4 mm. from the end of the range, the ionisation increasing to about twice its value at the commencement. The mean range is found to be 3·87 cm. Comparison of the ionisation curve with the semi-theoretical formula of Mano-Bethe-Bloch shows good agreement for the second half of the range but at the commencement the experimental curve lies above the theoretical. This signifies that the energy interchange is a function of the velocity. Occasionally the number of ions formed towards the end of the track is 5 or 10 times the mean value. In explanation it is supposed that the excess ionisation is produced by a collision process between mainly neutral particles and gas atoms. The straggling is represented by a range variation of 3·74 ± 0·17 mm., which is somewhat greater than that to be expected theoretically; also the individual ranges are asymmetrically distributed about the most probable range. F. C. C.

***2045. Counter of Wynn-Williams Type. S. Kikuchi and H. Aoki.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 543. *pp.* 36–41, *Jan.* 1935. *In English.*—The optimum arrangement of the components of the circuit for a counter of the Wynn-Williams type is determined. The amplification is linear and the instrument is shown to behave satisfactorily for counting α-particles. Particles producing low specific ionisation are not recorded and response to a γ-ray source is attributed to the accidental coincidence of a large number of secondary β-particles. [See Abstract 1311 (1935).] F. C. C.

2046. Statistical Error in Counting Experiments. R. Peierls. *Roy. Soc., Proc.* 149A. *pp.* 467–486, *April* 10, 1935.—Various methods of determining the mean life of a source from the counter readings are discussed, and the method leading to the least error is described. It is found that the most probable mean life depends only upon the arithmetic mean of the times at which particles have been recorded. If the measurements are continued by re-activating the source over and over again the accuracy reached in the whole series is greatest if the source be allowed each time to decay to about 2 % of its initial intensity before re-activating. A simple method is given to take the natural effect of the counter into account. It is shown that this method sufficiently accurately approximates the most probable value of the life time. The formula for the latter is derived, but it is too complicated for practical use. The determination of an absorption coefficient is discussed. AUTHOR.

2047. Point Discharge Method of Measuring the Emanation Content of the Atmosphere. O. Macek and W. Illing. *Gerlands Beitr. z. Geophys.* 43·4. *pp.* 388–418, 1935.—The difference in the results obtained by Aliverti with his point discharge method [see Abstracts 558 (1933) and 2833 (1934)] from those obtained by the direct method [see Abstract 2402 (1934)], amounting in many cases to 50 %, is traced to the use of a wrong standardising formula, a correcting factor, a, for a.c. (50 ∼) 0·50, for d.c. $0{\cdot}94_5$, being required (and a larger correction for higher frequencies). Thus corrected the point discharge method gives satisfactory results. The maximum, mean and minimum values at Innsbruck for Rn were in 1933 (March–July) 2580, 436 and 23, and in 1934 (May–June) 1780, 432, and 72×10^{-18} curie /cm.^{3}, and of Tn in 1933 9·5, 2·76 and 0·53 atoms /cm.^{3}, giving a Rn/Tn ratio of 15000–10^5. Variation with time of day and of year, and meteorological conditions are discussed, the results agreeing substantially with those previously obtained. C. A. S.

See also Abstracts 1900, 1901, 2074, 2217, 2280, 2290.

RADIATION.

ABSORPTION AND TRANSMISSION.

***2048. Green Monochromatic Filter. B. Lyot.** *Comptes Rendus*, 200. *pp.* 738–739, *Feb.* 25, 1935.—The properties of a filter consisting of a combination of neodymium glass with Schott VG3 glass are given. A narrow band of about 100 Å effective width, with maximum transmission at 5600 Å, can be obtained. It is more convenient to use a saturated solution of neodymium nitrate instead of the neodymium glass, but this has the disadvantage of reducing the transmission very considerably. D. H. F.

See also Abstracts **1941, 1943, 2024, 2213. 2305.**

COLORIMETRY.

2049. Rapid Mathematical Methods for Trichromatic Colorimetry. J. G. Holmes. *Phys. Soc., Proc.* 47. *pp.* 400–412, *May* 1, 1935.—Methods are suggested for reducing the labour involved in colorimetric transformations, with particular application to routine industrial measurements. The calibration of an instrument by measurement of illuminant *B* is replaced by measurement of a suitable stable filter and the illuminant in usual use. A nomographic method of conversion from instrument readings to the C.I.E. basis is suggested, and a graphical method is given for conversion to terms of hue and saturation. Scales are given for a graphical method of converting from the spectrophotometric curve of a coloured specimen to the trichromatic coefficients with a series of illuminants on the C.I.E. basis. The errors of these methods are estimated for comparison with the errors of observation on a Hilger-Guild trichromatic colorimeter. AUTHOR.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

2050. Magnetic Rotatory Power of Ammoniacal Nitrogen. R. de Mallemann and P. Gabiano. *Comptes Rendus*, 200. *pp.* 823–824, *March* 4, 1935.—The magnetic rotatory powers of ammonia and mono-, di- and tri-methyl- and ethyl-amines have been determined for 5780 Å. Allowing for unavoidable impurities in the amines, the values for N. NH, and NH_2 are the same, 7×10^{-5}. The ratios of the values for the gaseous and liquid conditions all (except $NH_3 = 0{\cdot}90$) lie between 0·80 and 0·84. C. A. S.

2051. Objective Study of the Allison Magneto-Optic Method of Analysis. M. A. Jeppesen and R. M. Bell. *Phys. Rev.* 47. *pp.* 546–548, *April* 1, 1935.—Objective methods have been used to investigate the reliability of the Allison magneto-optic method of analysis. Readings have been taken by a large number of unbiased observers to reduce the personal factor. Probability theory has been introduced to determine how much of the data can be explained as random. Minima in fair agreement with Allison's results have been obtained with the usual set-up, but just as good agreement has been obtained with wrong solutions in the cells, or none at all. This indicates that the minima are not a function of the chemical solutions used. AUTHORS.

2052. Allison Magneto-Optic Apparatus. T. R. Ball. *Phys. Rev.* 47. *pp.* 548–551, *April* 1, 1935.—The Allison magneto-optic apparatus has been subjected to critical tests by the checking of minima reported from other laboratories, by the working of unknowns and by the distribution of scale readings over a given range. About 300 of Allison's minima have been checked. Two sets of three unknowns, prepared in such a way that there was one chance in six of a fortuitous correct solution, have been successfully analysed. One set in which three salts were chosen out of a list of seven was correctly analysed after the three had been mixed. The chances were 34 to 1 against a lucky selection of the correct combination. A second set of three out of seven, similarly run, resulted in the identification of only one constituent. The overall average shows 10 out of 12 correctly reported. All unknowns were given to the observer at concentrations of 1 part in 10^7 of water and they were diluted to 1 part in 10^{10} before subjecting to analysis. A statistical study has been made of the distribution of 1,698 scale readings, made over a period of three years by five different observers. The readings were plotted against the number of times they were observed and definite peaks are evident in the curve. 84·2 % of all readings fall within the limits of experimental error of a peak, and 30·1 % fall on a peak. This is contrary to the results of Slack and of MacPherson, who found only chance distribution [see Abstract 1561 (1935)]. AUTHOR.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2053. Quenching of Fluorescence of Liquids by Halogen Ions. E. Schneider. *Zeits. f. phys. Chem.* 28. *Abt. B.* 4. *pp.* 311–322, 1935.—The quenching of fluorescence is linked up with photooxidation of iodide solution. The dependence of the iodine output on the oxygen and iodine concentration has been investigated. The quantum efficiency of iodine production in relation to the quanta absorbed by the fluorescing dyestuff has been measured and is found to be of the order of unity. The results indicate the following reaction: $I^{-}\cdot HOH + Q = I\cdot H + OH^{-}$, where Q = energy which would correspond to fluorescence if no quenching occurred. J. E.

2054. Mechanism of Photoluminescence in Dyestuff Phosphors. A. Jabłoński. *Zeits. f. Physik*, 94. 1–2. *pp.* 38–46, *March* 12, 1935.—The author assumes that the existence of phosphorescence implies the existence of a metastable state (M). Since the probability of transition to this state from the ground is extremely small phosphorescence will only be appreciable if there exists an unstable state (F) at a higher level than M from which the molecule can fall to M. The consequences of this assumption are developed and shown to be in general agreement with qualitative results. J. E.

2055. Brightness of Fluorescent Screens under Electronic Bombardment. M. v. Ardenne. *Zeits. f. techn. Physik*, 16. 3. *pp.* 61–67, 1935.—The author has examined a number of fluorescent materials and has determined their brightness and the spectral distribution of the emitted light when the materials are bombarded with electrons having a velocity of 4000 V. The spectral distribution is found to depend on the intensity of the bombardment owing to the fact that the long-wave bands in the spectrum reach saturation before the short-wave bands. The results are compared with the fluorescence of the same materials under X-ray and ultra-violet radiation. J. W. T. W.

See also Abstracts 2072, 2073, 2159, 2160, 2161.

INTERFERENCE. DIFFRACTION AND SCATTERING.

2056. Theory of Molecular Scattering of Light in a Non-Uniformly Heated Crystal. M. Leontovič. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 97–110, *Jan.* 21, 1935. *In German.*—It has been shown by Mandelstamm that the intensity of the molecular light scattering in a crystal which is not uniformly heated depends not only on localised temperatures, but on the temperature distribution throughout the medium, and also on the absorption coefficient of the substance for sound waves. This dependence is now investigated quantitatively, on the basis of a model in which the Brownian movement of a one-dimensional chain of mutually elastically bound particles in a resisting medium under the influence of occasional thrusts is considered, the temperature varying from point to point in the medium. C. B. A.

2057. Fine Structure of Rayleigh Scattering. L. S. Ornstein and P. H. van Cittert. *Physica,* 2. *pp.* 221–229, *March,* 1935. *In German.*—The experiments of Ramm [see Abstract 4506 (1934)] confirm the Brillouin theory of the fine structure of Rayleigh scattering, which predicts two components of slightly modified frequency due to scattering by elastic waves. In the present theoretical paper it is shown that consideration of the scattering by the discrete lattice points gives an explanation of the central component of unmodified frequency which is also observed in the experiments. L. A. W.

***2058. New Interferometer System and Some Applications. Q. Majorana.** *Rev. d'Optique,* 13. *pp.* 393–404, *Dec.,* 1934.—A description is given of a method of producing interference in which the interfering beams come, one from the source direct and the other through a very thin prism (" monoprism "), the refracting angle being about 1°. The simple theory of the method is developed and a comparison with other systems (*e.g.,* Lloyd's mirror) is made. The following applications and some results are described: measurements of the refractive indices of gases; observations of the Doppler effect; and an investigation of the effect of movement of the source on the velocity of propagation of light in space. In the latter case, no effect could be detected. C. B. A.

See also Abstracts 2032, 2148, 2198.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2059. Photochemical Elementary Process in Alkali Halide Crystals. R. Hilsch and R. W. Pohl. *Göttingen Nachrichten,* 1. 9. *Fachgruppe* 2. *pp.* 115–127, 1934.—Use has been made of " sensitised " crystals of KCl and KBr (two methods of sensitisation are described), with well-defined light absorption, to measure the dependence of photochemical yield on the temperature. At low temperatures (liquid air) this yield vanishes, and at high temperatures it reaches a maximum value of about 1. At temperatures above + 140° C. the colour-centres become thermally mobile, flocking and decolorisation occurring, so that the results obtained depend on the rapidity of measurement. With crystals artificially sensitised the maximum yield is reached at about 50° C. Over a wide range of temperature, the dependence of the yield on the temperature is expressible by $\eta = Ce^{-0\cdot85 \text{ e. volt}/kT}$, T being the absolute temperature. The value of C varies from 5·6 to 9·5 and is related to the number of impacts which an electron can undergo after the act of absorption. The results obtained with crystals of KBr agree well with observations on photographic plates. T. H. P.

2060. Kinetics of Recombination of Bromine Atoms. E. Rabinowitch and H. L. Lehmann. *Faraday Soc., Trans.* 31. *pp.* 689–705, *April*, 1935.—By exact compensation of the photo-currents produced by two light beams from the same source in falling on two Se-Fe photocells, intensity changes of less than 0·01 % can be measured. The stationary change of concentration of molecules in Br_2 vapour illuminated by a high-current carbon arc is detectable in this way. This effect is due to (1) dissociation of bromine into atoms and (2) non-uniform distribution of temperature and concentration in the illuminated vapour. Addition of small amounts of He, A, N_2 or other gas to Br_2 lowers the effect greatly, whilst that of larger amounts increases it again to a maximum and then decreases it slowly. For certain simplified conditions, formulæ are given for the thermal, heterogeneous and homogeneous equilibria, and comparison of these formulæ with the experimental curves reveals various points of agreement. The velocity of the homogeneous recombination of Br in He is inversely proportional to the square root of the pressure, in accord with the simple three-body mechanism: $Br + Br + X \rightarrow Br_2 + X$, but not in accord with possible mechanisms involving the molecule Br_3. T. H. P.

2061. Influence of Alkali Iodides on the Properties of Photographic Emulsions. A. Charriou and (Miss) S. Valette. *Comptes Rendus*, 200. *pp.* 916–918, *March* 11, 1935.—Further experiments [see Abstract 1453 (1933)] have been made with the help of more exact sensitometric methods. The results obtained show that: (1) As the content of iodine ions in a photographic emulsion increases, the sensitivity decreases to a minimum and then increases. (2) The higher the proportion of AgI in the emulsion, the less is the initial fall in sensitivity under the influence of iodine ions and the greater the subsequent rise. (3) As the content of iodine ions increases, the liability of the emulsion to solarisation rises to a maximum and afterwards diminishes, the maximum corresponding with the minimum sensitivity. These results invalidate hypotheses which attribute the de-activating properties of the halides to a simple halogenation of the silver nuclei liberated by reduction of the AgBr during the preparation of the emulsion. T. H. P.

***2062. Photographic Plates for Use in Spectroscopy and Astronomy. Part IV. C. E. K. Mees.** *Kodak Research Lab., Comm. No.* 487. *J.O.S.A.* 25. *pp.* 80–83, *March*, 1935. *Phot. J.* 75 *pp.* 188–190, *April*, 1935.—The three characteristics—sensitivity, contrast and graininess—of each of the five emulsions previously described [see Abstract 4064 (1933)] all change systematically in the same direction in going from type I to type V. When type IV emulsions are sensitised to produce type R sensitivity it is found that the plates have a high R sensitivity corresponding to type I. The emulsion is therefore designated by three separate figures, the first referring to the sensitivity, the second to the contrast and the third to the graininess, the figures indicating the type of unsensitised emulsion possessing the qualities referred to. Advances in the production of polycarbocyanine dyes has resulted in a considerable simplification in the preparation and handling of type Q plates and in two new infra-red sensitisings. One—type M—gives an emulsion with a strong maximum at $\lambda\,9300$, the spectrum extending from $\lambda\,8000$ to $\lambda\,10{,}000$ and with much greater sensitivity than type Q, the other—type Z—has a sensitivity maximum at $\lambda\,10{,}900$ and extends up to $\lambda\,12{,}000$. Wedge spectrograms for types M, Q and Z sensitising, and a diagram of the spectral sensitivity region of spectroscopic plates including the most recent advances, are given. [See Abstract 3504 (1933).] R. C. F.

2063. Bleached-Out Pictures by Diffuse After-Illumination. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 33. *pp.* 266–272, *March*, 1935.—Discusses the effects of the diffuse illumination of exposed plates and shows that the bleached-out pictures obtained with silver bromide plates are due to a destruction of the ripened nuclei. It is the inner nucleus which is the determining part of the complete nucleus and this is destroyed by exposure to light in the presence of the desensitiser. Silver iodide plates show similar results, it being possible also to obtain this bleached-out effect without a desensitiser. R. C. F.

2064. Three-Colour Additive Photography. A. J. Bull. *Phot. J.* 75. *pp.* 67–71, *Feb.*, 1935.—Indicates what has been accomplished in additive-colour photography screen plate work, showing also that there is need for more experimental work as to the best type of photographic record and the most suitable colours for reproduction. After a brief historical introduction, the different types of screen plates are considered in chronological order, coloured photomicrographs of some of the screen plate mosaics being given. Finally, in order to ensure that the optical foundations of the subject are not lost sight of the results and conclusions of Clerk Maxwell, Abney, Mees and Pledge are described. R. C. F.

***2065. Coloured Screens for Stereoscopic Projection. L. Lumière.** *Comptes Rendus*, 200. *pp.* 701–704, *Feb.* 25, 1935.—Briefly describes a modification of Alméida's method of stereoscopic projection, using red and green coloured filters, one in each of the stereoscopic projection beams, the observer being supplied with filters similarly coloured. This method rapidly gives rise to eye fatigue, and in order to overcome this the present author suggests using screens or filters so coloured that each eye receives equal amounts of luminous energy. This is attained by using one filter transmitting light of wave-length 550–640 $m\mu$ and the other transmitting the remainder of the visible spectrum, the method of producing the filters being described. In order to overcome the vertical parallax introduced by horizontal motion of the film, a special viewing apparatus is described in which the coloured screens are arranged one above the other in accordance with the photographs on the film. Prisms are used to obtain the 70 mm. displacement between the images which is necessary for viewing purposes. R. C. F.

***2066. Ultra-Rapid Kinematograph Camera for 9 mm. Films, Giving 1,500 to 2,000 Images per Second. A. Magnan.** *Comptes Rendus*, 200. *pp.* 804–805, *March* 4, 1935.—Briefly describes developments introduced since 1931 [see Abstract 3431 (1931)] dealing particularly with a camera taking a 9 mm. film and giving 1500–2000 exposures per sec., each negative being 9 × 7·5 mm. The film speed is 15 m. per sec., and the camera is equipped with a 5-opening rotating shutter driven at a speed of 400 r.p.s. Direct development of the film as a positive is used, and a projection speed of 16 per sec. suggested as giving an excellent reduction. R. C. F.

***2067. Visual Densitometer and Reflectometer. E. R. Davies and R. E. Owen.** *Kodak Research Lab. Comm. No. H540. Phot. J.* 75. *pp.* 128–136; *Disc.*, 136–137, *March*, 1935.—Describes an instrument designed for the accurate determination of the contact opal densities of photographic negative materials and the reflection densities of exposed photographic papers. Maxwellian view of a Lummer-Brodhun cube with simple vertical dividing line is used for the comparison of (*a*) the brightness of either the paper or the opal-backed negative with (*b*) a piece of opal of variable brightness. The variation is obtained by means of a variable sector disc over a range of density equal to 1, step-up densities being employed in series with the sector to extend the total range. The range 0 to 3 can be covered without appreciable error, but at greater densities the error increases progressively. The scale of the sector disc is calibrated experimentally both by visual and by photoelectric methods. The results are given of a study of the effect of thickness of the opal backing on the value obtained for contact opal densities. In the *Discussion* several speakers referred to the effect of backing on the value obtained for a reflection density and **L. V. Chilton** and **E. R. Davies** gave an explanation of the effect. The reflection density is defined as the logarithm of the ratio of the brightness of a piece of photographic paper that has been fixed out (and so contains no silver) to that of the part of the print in question, both being illuminated by parallel light at 45° and viewed normally. If the paper base is thin, the effect of the backing may be different for the two surfaces being compared. J. W. T. W.

***2068. Linear Photoelectric Densitometer. C. W. Miller.** *Rev. Sci. Instruments*, 6. *pp.* 125–127, *April*, 1935.—A photoelectric densitometer is described which makes use of the remote cut-off characteristic of a 58 type thermionic valve to give a meter reading which is very nearly proportional to density. Commercial a.c. is utilised throughout, resulting in a convenient and portable type of instrument. A method is described by which it can also be used to measure the blackness of opaque objects. AUTHOR.

***2069. Measurement of Time and Efficiency of Photographic Shutters. E. D. Eyles and E. W. H. Selwyn.** *Phys. Soc., Proc.* 47. *pp.* 446–454, *May* 1, 1935.—Apparatus is described for obtaining the curves relating area with time in photographic between-lens shutters. A set of separated and illuminated apertures fitted with neutral glass filters passing certain standard fractions of the light is imaged by a lens on film wrapped round a revolving drum, the shutter acting as a diaphragm for the lens. The film is thus exposed in bands along its length. An exposure is made, with the shutter set fully open, for one revolution of the drum. The above apertures are then replaced by a second set without neutral filters, each of these apertures fitting exactly between the spaces previously occupied by two apertures of the previous set. An instantaneous exposure of the shutter is then made during another revolution of the drum. During the whole of this exposure a time scale is impressed on the film by subsidiary apparatus. After development the points at which adjacent bands have the same density are found. These give the times at which the area of opening of the shutter was equal to the standard fractions of its full aperture. Various features of the apparatus are discussed, and particulars are given of the method of calibrating the neutral filters and of tests carried out on shutters for which curves relating area with time could be calculated. **Authors.**

See also Abstracts **2053, 2135, 2197.**

PHOTOMETRY.

***2070. Neon Lamps in State of Counters. Part I. Limits of the Field of Photoelectric Sensibility. G. Valle and B. Rossi.** *N. Cimento,* 11. *pp.* 708–716, *Dec.,* 1934.—Investigation was made of the conditions in which the ordinary neon lamps of commerce could be maintained in the state of counters like those of Rajewski [see Abstract 2421 (1931)], and thus reveal their photoelectric sensibility which extends also to visible light. It is found that the field within which the phenomenon is manifested is limited upwards by a maximum value of the velocity of increase dV/dt of the potential between one impulse and the succeeding one. Illumination, besides increasing the mean frequency of impulses, reduces the limiting value of dV/dt, restricting the field of sensibility by a further increase of the intensity of illumination. This effect increases, but always more feebly, with the illumination itself. J. J. S.

***2071. Apparatus for Photon-Counter Investigations. K. H. Reiss.** *Zeits. f. Physik,* 93. 5–6. *pp.* 411–415, *Jan.* 19, 1935.—The intensity of the light emerging from a monochromator is determined by means of a bolometer, which is described, and the same beam is then thrown on to a photon-counter after passing through a filter of known transmission. The production of a photon-counter with a Cd kathode is described. Results for the photoelectric output per incident photon, and for the long-wave threshold, are given. D. H. F.

2072. Spectral Sensitivity of Photon Counters. R. Audubert and C. Reithmuller. *Comptes Rendus,* 200. *pp.* 389–391, *Jan.* 28, 1935.—The comparative sensitiveness of various photokathodes used in the photoelectric counter has been determined and plotted (in arbitrary units) against wave-length for 2000–4000 Å. The most sensitive are Al, CuI_2, Cu_2O, SnO, Cd, CdS and Zn amalgam, while oxidised Ta, Mg, Cu_2S, PbS and PbI_2 are less satisfactory. It is thus possible, by proper choice of the photokathode, to examine, at least roughly, the spectrum of the radiation emitted by a chemical reaction [see Abstract 4051 (1933) and following Abstract]. C. A. S.

2073. Sensitiveness of Photon Counters. R. Audubert. *Comptes Rendus,* 200. *pp.* 918–920, *March* 11, 1935.—The small amounts of light energy to which the highly sensitive cells required respond may be determined as follows. The counter is subject to the radiation from a mercury vapour resonance lamp giving radiation of 2535·7 Å of intensity measured by comparison with a Hefner standard by means of a Zeiss thermoelectric pile and a Zernicke galvanometer. Such intensity I_0 is reduced by a 0·3 — 1 % solution of acetone in alcohol. From two measurements with different thicknesses, d and d_1, of the same solution, the coefficient of absorption may be calculated from $K : \frac{n}{n_1} = 10^{-K(d-d_1)}$, n and n_1 being the corresponding increases in the frequency of the discharge. The intensity I is then determinable: $I = I_0 \cdot 10^{-Kd_1}$. The limiting sensitiveness of any one substance varies greatly between one electrode and another, and a number of cells are often necessary to obtain suitable sensitiveness. Study on these lines of various reactions emitting radiation shows the order of magnitude of the emission to range from 10^{-6} to 10^{-9} erg/sec./cm.^{2} [see preceding Abstract]. T. H. P.

***2074. Hydrostatic Counter for Ionising Radiations and Photoelectrons. H. Greinacher.** *Helv. Phys. Acta*, 8. 1. *pp.* 89–96, 1935. *In German.*—A description is given of a so-called hydrostatic counter which differs from the previously described hydraulic counter [see Abstract 4138 (1934)] in having a liquid surface at rest near to a pointed iron electrode. The passage of α-, β- or γ-rays or the liberation of photoelectrons from the liquid causes such intense sparks as to operate a loud-speaker directly. Photographic recording is possible by the use of an insensitive leaf electroscope. An arrangement is also described in which the hydraulic counter is used as indicator in conjunction with the hydrostatic counter. It is pointed out that the hydrostatic counter has the advantage that it makes possible the measurement of the photoelectric effect of a liquid of which only a small quantity is available. L. A. W.

***2075. Geiger Point Counter for Light Measurement and its Application. B. Sturm.** *Zeits. f. Physik*, 94. 1–2. *pp.* 85–103, *March* 12, 1935.—A new design of point counter is described, consisting of a brass tube one end of which is fitted with a quartz window and the other with a metal plate. The point, which is of Pt is situated axially in the tube, facing and at a short distance from the end plate which may be of Pt, Cd, Zn, Cu or Ni. The count potential characteristic is flat between 880 and 900 V. A magnetic field first increases and then strongly decreases the number of counts. The sensitivity is constant for light incident on the metal plate over a central area of 3·5 sq. cm. and is the same as that for a tube counter. The advantage of the former lies in its more rapid action which results in increased resolving power. Applications of the instruments to problems concerned with radioactivity, spectroscopy and mitogenetic radiations are suggested. F. C. C.

***2076. Sodium Discharge Lamp as Intensity Standard. H. Schmellenmeier.** *Zeits. f. Physik*, 93. 11–12. *pp.* 705–725, *Feb.* 26, 1935.—The possibilities of gas discharge lamps as reproducible standards of light intensity, and the disadvantages for this purpose of the Hefner lamp, the filament lamp and the black-body radiator, are discussed. The construction of a special form of sodium discharge lamp is described. Experimental results show that its radiation is practically independent of current strength over a wide range, and that a 1 % increase of vapour pressure produces an increase of about 1 % in intensity. The limit of variation in intensity between different lamps of this kind is ± 2 %. An attempt is made to cover these results theoretically, together with other phenomena such as line broadening and re-absorption. D. H. F.

***2077. Operation of the Nernst Lamp. P. Leroux.** *J. de Physique et le Radium*, 6. *pp.* 65–68, *Feb.*, 1935.—Examines, by means of a rock-salt prism spectrograph, the emission of two Nernst lamp filaments, in the region 0·5 to 9·0μ, for various operating currents. Measurements of the filament temperatures in three different regions of the spectrum are also given for the different operating conditions. The emission curves obtained show marked peaks which are dependent on the filament materials and on the operating current, becoming smaller as the latter is decreased. Provided the normal intensity is not exceeded it is possible to obtain an emission which remains constant when the measurements are taken after long time intervals, and which is easily controlled by an ammeter. R. C. F.

See also Abstracts **2067**, **2068**.

POLARISATION.

2078. Rotatory Power of α-Phenylethylamine and its Halogen Salts. Yeu ki Heng. *Ann. de Physique*, 3. *pp*. 270–319, *March*, 1935.—The variations in the rotatory power of solutions in water and in alcohol of the halogen salts of *d*– and *l*– α-phenylethylamine with concentration, together with their absorption spectre indicate that the kations are deformed in the field of the anion, but probably only the amine portion thereof. The effect on the rotatory power of the hydrochloride of the addition to its solution of varying amounts of **55** salts, inorganic and organic, has also been examined. The variations are in most cases also explicable as due to deformation of the active kation by the field of the added anion, in which respect the order of activity is F > Cl > Br > I, $ClO_3 > BrO_3 > IO_3$, and polybasic acids > monobasic. In some cases, *e.g.* solium butyrate, association seems to occur and the effect is large, but where there is combination, *e.g.* with sodium oxalate or maleate, it is small. The effect of successive members of the mono- and di-basic fatty acid series shows to some degree the usual alternations for odd and even members [see Abstract **464** (1929).] C. A. S.

See also Abstract **2311**.

RADIATION, EMISSION.

2079. Recent Studies of the Ionosphere. S. S. Kirby and E. B. Judson. *Bureau of Standards, J. of Research*, 14. *pp*. 469–486, *April*, 1935.—Results of ionosphere measurements utilising transmissions at vertical incidence and made weekly over a period of 18 months are discussed. Typical graphs of diurnal variations of the E-layer critical frequency and its relation to the ionising force of the sun are shown for three seasons. Similar graphs for the F_2-layer are included as well as a seasonal curve of midday, and maximum critical frequencies of this layer. The absence of midday F_2-critical frequencies during the summer is pronounced. A sporadic E-layer appearing at the same virtual height as the normal E, and after the normal E has reached its critical penetration frequency, is discussed. A comparison of its appearance with local thunderstorms is tabulated. The presence of a tentatively named G-layer is indicated. AUTHORS.

2080. Absorption of Cosmic Radiation. P. Auger. *Comptes Rendus*, 200. *pp*. 739–742, *Feb*. 25, 1935.—Coincidence experiments were carried out at a depth of 8 m. of earth, and the absorption of the radiation by lead determined. Two groups of rays are reported with mean coefficients of absorption for lead of $0 \cdot 7 \times 10^{-3}$ cm.²/gm. and 35×10^{-3} cm.²/gm. The harder group has the same coefficient for air and earth as for lead but the softer group has a coefficient of 5×10^{-3} cm.²/gm, in air and earth. Other experiments [see Abstract 5002 (1934)] have shown the presence of a shower-producing radiation with the properties of this softer component and the interpretation of these results is discussed. It is concluded that the mechanism of the absorption of the hard and soft groups by nuclear collisions must be very different. D. H. F.

2081. Variation of Cosmic Radiation with Atmospheric Pressure. Barometer Paradox. Influence of Clouds. J. Clay. *Physica,* 2. *pp.* 189–195, *March,* 1935. *In English.*—The variation of the radiation in Bandoeng with the barometer was recorded with different shields. With a shield of 9 cm. lead there appeared an effect that was in phase with the barometer, hence opposite to the normal effect. This may be explained by the supposition of the existence of an intermediate photon radiation. The normal influence of the clouds is a decrease of the observed ionisation and of the number of fourfold coincidences. But with 9 cm. lead the influence is compensated, which may be also explained by the photon intermediate radiation. AUTHOR.

2082. Intensity Variation of Cosmic Radiation at Different Heights. J. Clay and P. M. van Alphen. *Physica,* 2. *pp.* 183–188, *March,* 1935. *In English.*—The results of two series of measurements at 53° magnetic latitude N. and 18° S. up to 5000 m. of the ionisation in a vessel (4 L. 45 atm. argon) in a shield of 8 cm. Fe, closed and open at the top are given. It was found that the ionisation was much higher at 53° N. latitude. The radiation at 18° S. has the same nature at every height in the equatorial region and the same as the radiation at 53° N. latitude which penetrates the 8 cm. Fe. A comparison is made with results by means of the instrument at different heights on the earth. AUTHORS.

2083. Variation with Altitude of the Production of Bursts of Cosmic-Ray Ionisation. C. G. and D. D. Montgomery. *Phys. Rev.* 47. *pp.* 429–434, *March* 15, 1935.—The rate of occurrence of bursts of ionisation from 140 pounds of lead shot was measured in a 50 l. Dowmetal ionisation chamber, filled with nitrogen at 14·5 atmospheres pressure, at four elevations between sea-level and the summit of Pike's Peak (4300 m.). The ionisation chamber was so designed as to minimise the random fluctuations of the cosmic-ray ionisation. The increase in the rate of occurrence with elevation was found to be very large, and increasingly greater at higher elevations. The rates of occurrence of all sizes of bursts greater than $1 \cdot 5 \times 10^6$ ions in the chamber increased with elevation in the same manner. The results are discussed in the light of W. F. G. Swann's theory. AUTHORS.

2084. North-South Asymmetry of Cosmic Radiation. G. Lemaître, M. S. Vallarta and L. Bouckaert. *Phys. Rev.* 47. *pp.* 434–436, *March* 15, 1935.—The development of the theory of the latitude and azimuthal effects is reviewed and the significance of Johnson's experiments on the north-south asymmetry is brought out. Störmer's critical remarks are commented on with reference to Lemaître and Vallarta's paper and to recent papers by Lemaître and by Bouckaert. AUTHORS.

2085. Frequency and Magnitude of Cosmic-Ray Bursts as a Function of Elevation. R. D. Bennett, G. S. Brown and H. A. Rahmel. *Phys. Rev.* 47. *pp.* 437–443, *March* 15, 1935.—Measurements of the magnitude and frequency of cosmic-ray bursts have been made at elevations of 185, 1620, 3240 and 4300 m. above sea level for periods of time ranging from 189 to 336 hours, using one of the new cosmic-ray intensity meters of the Carnegie Institution. Only bursts releasing more than 10^7 ion pairs are considered. The rather meagre data which could be collected in these short times of observation indicate that: (1) Burst-frequency decreases with burst magnitude in a way which can be represented by a series of exponentials. (2) These large bursts contribute only a small fraction of the total ionisation. (3) The magnitude of the largest burst observed increases rapidly with altitude, one observed at 4300 m. elevation exceeding 10^9 ion pairs or 3×10^{10} electron volts of energy released in the chamber. AUTHORS.

2086. Secondary and Tertiary Particles Produced by Cosmic Rays. J. H. Sawyer, Jr. *Phys. Rev.* 47. *pp.* 515–521, *April* 1, 1935.—Cosmic-ray secondaries and tertiaries have been studied in a series of experiments. It has been shown that the secondaries from Pb have little power to produce detectable tertiaries or showers from Pb or Al. The secondaries from Al have been found to produce more showers in Pb than the secondaries from air. The absorption coefficient of the secondaries from Al has been found to be 0·7 cm.$^{-1}$ Pb and the absorption coefficient of their Pb tertiaries 2·0 cm.$^{-1}$ Pb. The values for secondaries from air and a heavy roof, and their Pb tertiaries were previously found to be 0·5 cm.$^{-1}$ Pb and 2·58 cm.$^{-1}$ Pb. The values obtained from Rossi's and Funfer's data are 0·32 cm.$^{-1}$ Pb for the air secondaries and 1·18 cm.$^{-1}$ Pb for their Pb tertiaries. It follows that the air secondaries and their Pb tertiaries have greater energies than the Al secondaries and their Pb tertiaries. It has been found that a component of the cosmic rays even softer than the corpuscular component is probably the chief source of the secondaries producing the showers. There is some evidence that non-ionising particles produce a portion of the showers and that possibly non-ionising secondaries are produced in Pb and that these particles can produce ionising particles in Al. AUTHOR.

***2087. New Sources of Ultra-Violet Light and Some Applications. J. Roger.** *R.G.E.* 37. *pp.* 319–326, *March* 9, 1935.—Three modern types of ultra-violet lamps are discussed and described : (1) An ordinary incandescent filament lamp in which the filament is subjected to excess voltage, thus increasing the temperature and the u.v. emission. (2) A new type of atmospheric pressure mercury arc ; the mercury is volatilised by means of a tungsten filament, the arc striking when the vapour pressure is sufficiently high. (3) Low-pressure mercury arcs which can be used either in quartz or u.v.-transparent glass containers. A comprehensive table is given showing the characteristics of the lamps described. Spectra show the concentration of the light in the " active " region of the solar spectrum (2700–3200 Å). Tests of a number of reflectors for u.v. show that aluminium gives the highest reflection factor. The biological effects of u.v., with special reference to erythema production, are discussed, and quantitative comparisons between the various lamps and the sun are made. A number of applications of the new lamps in zoological and botanical work are described. J. E. R.

See also Abstracts 1894, 1982, 2076, 2077, 2152, 2258.

RADIATION, GENERAL THEORY.

2088. Matrices of the Theory of the Photon. G. Petiau. *Comptes Rendus*, 200. *pp.* 374–375, *Jan.* 28, 1935.—Derives certain mathematical relations between the 16 row and 16 column matrices occurring in the new wave equation for the photon recently put forward by de Broglie. [See Abstract 4175 (1934).] W. S. S.

2089. Thermal Equilibrium of Elementary Particles. G. Wataghin. *Comptes Rendus*, 200. *pp.* 909–912, *March* 11, 1935.—The statistical equilibrium between matter and radiation at temperatures $>$ about $1/Kmc^2$, at which the number of photons of energy $h\nu > 2mc^2$ capable of producing couples of electrons [see Abstract 2875 (1934)] is appreciable, and at which therefore the number of positive and negative electrons per unit volume varies with the temperature, is examined as it might be expected to exist in a limited space within a hot star, with the further assumption that all nuclei have been decomposed into protons and neutrons. The numbers of these and of photons, positrons, and electrons are deduced. It is suggested that the neutrino hypothesis evades the difficulty as regards the manner of emergence of cosmic radiation from the interior of certain stars (*e.g.* novae) if it originates there. C. A. S.

See also Abstract 2262.

REFLECTION. REFRACTION AND DISPERSION.

2090. New Derivation of the Gauss Optics Based on the Principle of Optical Duality. M. Herzberger. *Physica,* 2. *pp.* 239–254, *March,* 1935. *In German.*—In an attempt to develop the author's general duality principle in the field of Gauss optics, the surprising discovery is made that all rules for image formation by meridian rays are special cases of a simple law. Since the image formation by oblique rays in rotation systems can be reduced, through Lippich's law, to the case of meridian rays, the Gauss optics can be developed completely on this basis. C. B. A.

2091. Standard Conditions for Precise Prism Refractometry. L. W. Tilton. *Bureau of Standards, J. of Research,* 14. *pp.* 393–418, *April,* 1935.—Air as a standard reference medium for precise refractive-index measurements is discussed with respect to the precision necessary in the control and measurement of its temperature, pressure, humidity, and carbon-dioxide content. Particular attention is given to the selection of provisional values for α, the optical temperature coefficient for air; and the preparation of accurate correction tables for the reduction of refractive-index observations to standard conditions of reference is described and exemplified. The approximate range of temperature effects on absolute refractive index is indicated; also the range of pressure effects on liquids. A new (empirical) relation between index and density is derived from Pockels' optical data on elastically deformed glass and a basis for quantitative treatment of permissible stress-birefringence is given. For glasses, the character of annealing and the permissible degree of striation are considered; and for several media the requisite constancy in wave-length of light source is determined. Tolerance equations are given for all requirements that are quantitatively discussed and it is concluded that both precision and accuracy to within ± 2 or 3×10^{-6} can be attained in determining refractive index by the classical method of minimum deviation. AUTHOR.

2092. Rotating Prism Method for Photographic Measurement of Refractive Dispersion. P. Wulff and T. F. Anderson. *Zeits. f. Physik,* 94. 1–2. *pp.* 28–37, *March* 12, 1935.—A method is described by which it is possible to obtain, in a single exposure, the refractive dispersion of a prism in the visible and ultra-violet spectra. By means of two concave mirrors, light from a slit is refracted through the prism, which is made to rotate continuously during the exposure, and it is then brought to a focus on a photographic film. As the prism rotates, it passes through the position of minimum deviation for each line in the spectrum of the light source, leaving a sharp " edge " in the photogram from the position of which the minimum deviation angle can be deduced. Measurements on quartz, KCl and CsCl are described, and an accuracy of unity in the fourth decimal place is claimed. C. B. A.

2093. Constitution of Glasses. E. Jenckel. *Zeits. f. Elektrochem.* 41. *pp.* 211–215, *April*, 1935.—A discussion is first given of the possible curves to be obtained by plotting physical properties against composition, after which comes a detailed consideration with illustrative diagrams of the following binary glasses: $B_2O_3 - Na_2O \cdot 2B_2O_3$; $B_2O_3 - BaO \cdot 2B_2O_3$; $B_2O_3 - PbO$; $B_2O_3 - SiO_2$; $SiO_2 - Na_2O \cdot B_2O_3$; $B_2O_3 - Na_2O \cdot SiO_2$; $Na_2O \cdot SiO_2 - SiO_2$. Possible molecular compounds are indicated and experimental data included. H. H. Ho.

See also Abstracts **1968, 1998, 2000, 2058, 2149.**

SPECTROSCOPY.

2094. Wave-Length Table of the Vacuum Spark Spectrum of Fluorine. B. Edlén. *Zeits. f. Physik*, 94. 1–2. *pp.* 47–57, *March* 12, 1935.—This paper comprises a comprehensive wave-length table of the vacuum spark spectrum of F in the extreme ultra-violet. 525 lines are listed in the region 86 to 1139 Å and also 85 lines of F IV, F V and F VI in the region 4592 Å to 2171 Å. 8-fold magnified spectrograms of the region 113 to 275 Å are reproduced. Some extension of the analysis of the spectra of F V and F VI is made. J. E. K.

2095. Infra-Red Spectra of Noble Gases (10500 to 13000 Å). W. F. Meggers. *Bureau of Standards, J. of Research*, 14. *pp.* 487–497, *April*, 1935.—The first spectra of He, Ne, A, Kr and Xe, excited by uncondensed discharges in Geissler tubes, have been explored in the infra-red (10500 to 13000 Å) with Eastman I–Z photographic plates. In each spectrum new lines have been recorded, most of which are accounted for as combinations of established terms, thus confirming the structural analyses of the spectra. Two missing $2s$ terms are revealed for Xe and possibly one new f-type term each for Ne and for A. Among the stronger lines those which involve accurately determined relative terms may serve as preliminary standards of wave-length in the infra-red. AUTHOR.

2096. Arc Spectrum of Copper in the Infra-Red. C. C. Kiess. *Bureau of Standards, J. of Research*, 14. *pp.* 533–535, *April*, 1935.—A survey of the arc spectrum of copper out to the limit attainable photographically in the infra-red has yielded about 30 new lines. All, except one, are accounted for as combinations between previously known terms of Cu I. AUTHOR.

2097. Excitation of Balmer Series of Hydrogen to High Order of Terms by Electrodeless Discharge. H. Nagaoka, Y. Sugiura and T. Mishima. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 555. *pp.* 156–163, *Feb.*, 1935. *In English.*—Photographs of the discharge in hydrogen from a 125 kV transformer of frequency 6×10^6 cycles were taken axially along a tube of 10 cm. dia. containing the gas at low pressure. The Balmer series lines indicated that the hydrogen was present as protons or in the atomic state. Canal rays, ionising media and halogen compounds were introduced into the discharge and the effects are discussed. W. R. A.

2098. Atomic Spectrum of Oxygen. B. Edlén. *Zeits. f. Physik*, 93. 11–12. *pp.* 726–730, *Feb.* 26, 1935.—It is shown that 15 lines in the extreme ultra-violet hitherto attributed to oxygen [see Abstracts 4495 and 4502 (1933)] are actually due to impurities. The analysis of

O IV, O III and O II is supplemented. In O III 29 lines are classified and six quintet terms are determined. 16 lines in O II are identified as combinations with 11 new terms having the limit $2s2p^3\,{}^5S$. The classification of $3d - 4f$ and $\overline{3d} - \overline{4f}$ is somewhat modified. D. H. F.

2099. Arc Spectra of Alkali Metals at High Densities of the Metal Vapour. A. Carrelli and M. Battista. *N. Cimento*, 11. *pp.* 685–689, *Dec.*, 1934.—Measurements were made of the intensity distribution in forbidden lines corresponding to quantum jumps S → S, P → P, S → D, etc., in the arc spectra of Li, Na, and K, emitted under conditions of high density of the metallic vapour. The symmetry or asymmetry of the distributions is explained with reference to the location of the perturbing levels. The intensity distribution of continuous background was also measured for the alkalis Na, K, Rb and Cs. The results are interpreted as showing the formation of quasi-molecules to an increasing degree in passing from Na to Cs. W. S. S.

2100. Intensity Distribution in Spectral Lines Broadened by Pressure. R. Minkowski. *Zeits. f. Physik*, 93. 11–12. *pp.* 731–740, *Feb.* 26, 1935.—Measurements are made of the intensity distribution in the Na D-lines when pressure broadened by admixture of A. It is found, in agreement with recent theoretical predictions of Kuhn and London [see Abstract 5025 (1934)], that on the long-wave side of the lines the intensity decreases proportionately to $1/(\lambda - \lambda_0)^{3/2}$ and on the short-wave side proportionately to $1/(\lambda - \lambda_0)^2$ where λ_0 is the wavelength of the centre of the line. J. E. K.

2101. Transition Probability for the D Lines of Na from Absolute Intensity Measurements, Dissociation of Na Salts and Half-Width of the D Lines in the Air-Coal-Gas Flame. R. Minkowski, H. G. Müller and M. Weber-Schäfer. *Zeits. f. Physik*, 94. 3–4. *pp.* 145–171, *March* 19, 1935.—The transition probability as calculated from previous measurements of the absolute intensity of the D lines is appreciably smaller than that obtained from other measurements (magnetic rotation of the plane of polarisation and absorption of the D lines by saturated Na vapour). The discrepancy is due to neglect of the fact that the Na salt is only partially dissociated in the air-coal gas flame, a fact of which full account is taken in the present determination. Particulars are given of the construction of the burner and the sprayer used for the Na_2CO_3 solution, the determination of the total concentration of Na atoms present and of the concentration of free Na atoms, and the measurement of the reversal temperature of the flame and the absolute intensity of the D lines. The derived value of the transition probability is $(7{\cdot}2 \pm 0{\cdot}4) \,.\, 10^7$ sec.$^{-1}$ which agrees well with the results of other methods. The number of free Na atoms varies between 30 and 80 % of the total number present, a result in accordance with the presumably large deviation from thermal equilibrium. The half-width of the D lines derived from total intensity measurements for bright flames varies between $2{\cdot}3$ and $5{\cdot}9 \times 10^{10}$ sec.$^{-1}$ and attains a maximum at about 2500° K. [See following Abstract.] W. J.

2102. Transition Probability 2P — 1S of Sodium by Absolute Intensity Measurements of Flames. R. Minkowski and M. Weber-Schäfer. *Zeits. f. Physik*, 94. 3–4. *pp.* 172–175, *March* 19, 1935.—Remarks on an investigation with this title by van der Held and Ornstein [see Abstract 4988 (1932)] in which it was sought to avoid the erroneous assumption made in earlier determinations (including one by themselves in 1928) that all the Na atoms in the flame are free. The fact that only a certain percentage of the total present are free those authors attributed entirely to incomplete vaporisation of the droplets of solution introduced into the flame by the sprayer, and not, even in part, to incomplete thermal dissociation of the salt, which Ladenburg and Minkowski had previously shown thermodynamically and the present authors and Müller have now proved by direct measurement to be the important factor [see preceding Abstract]. In the present note it is pointed out that van der Held and Ornstein's borax-bead method of determining the number of free atoms is based on a false assumption, and that their determination of the transition probability is subject to errors which compensate that due to neglect of the incompleteness of the dissociation of the salt (75 to 80 % is dissociated at their flame temperature 2090° K.) and is therefore in agreement with results of other methods. W. J.

2103. Absolute Intensities in the Spectrum of Quartz Mercury Arcs and their Variation with Temperature Changes of the Surrounding Air. A. J. Maddock. *Phys. Soc., Proc.* 47. *pp.* 424–432. *May* 1, 1935.—Variations in intensity of the more important lines in the mercury arc spectrum are investigated as the temperature of the air surrounding the burner is increased. The intensity and arc watts reach maxima but not quite together. Empirical relations are found connecting intensity and electrical input. Absolute intensities of some thirty lines between 7000 and 2300 A. emitted by commercial quartz mercury-vapour burners are tabulated and some theoretical aspects of the results are discussed. AUTHOR.

2104. Intensity Ratio of the Hyperfine Structure Components of the Cæsuim Lines 4555 Å. D. A. Jackson and H. Barth. *Zeits. f. Physik*, 93. 11–12. *pp.* 809–813. *Feb.* 26, 1935.—When observed with a resolving power of about 10^5 the Cs line 4555 Å is found to consist of two components each of which consists of three unresolved components. The intensity ratio of the two components as given by the mean of 60 measurements, was found by Jackson to be $1\cdot27 \pm 0\cdot02$ [see Abstract 654 (1934)]. On the other hand Barth's determination of the ratio gave a value 1·41 [see Abstract 5027 (1934)]. In the present paper Jackson points out that Barth's determination was an average of only 8 measurements which gave values between 1·26 and 1·58 and that the value 1·26, which appeared twice, cannot be ruled out as a possibility from such a few measurements. Jackson contends, moreover, that Barth's measurements contain a systematic error due to his having used a resolving power of about 6×10^5 which would partially resolve the three components of each main component and would not therefore in practice provide the intensity ratio of the true sums of each set of three components. Barth in reply maintains that his resolving power was only $1\cdot6 \times 10^5$, that his results could not therefore contain the alleged systematic error and that the intensity ratio of 1·41 is not a false value even though it may not agree with the theoretical value of 1·29 calculated from the nuclear moment $I = 7/2$. J. E. K.

2105. Mechanical Moment of the Cobalt Nucleus. H. Kopferman and E. Rasmussen. *Zeits. f. Physik*. 94. 1–2. *pp.* 58–67, *March* 12, 1935.—Seven lines of the violet multiplet $3d^74s^2\,{}^4F - 3d^74s4p\,{}^6F$ of the CoI spectrum are investigated for hyperfine structure. From the observed structures it is concluded that the mechanical moment of the cobalt nucleus has the value $I = 7/2$. J. E. K.

2106. Hyperfine Structures in LaIII. Nuclear Magnetic Moment of Lanthanum. M. F. Crawford and N. S. Grace. *Phys. Rev.* 47. *pp.* 536–538, *April* 1, 1935.—Hyperfine structures of the resonance lines of La III. have been measured and the hyperfine structure separations of $6s\,^2S_{1/2}$, $6p\,^2P_{1/2,\,3/2}$ determined. A consistent value of 2·8 nuclear magnetons is obtained for the magnetic moment of the lanthanum nucleus from these separations. The $g(I)$ factors of several M odd Z odd nuclei with $I = 7/2$ are compared. AUTHORS.

2107. Nuclear Spin of Iodine. Part I.—Fine Structure in the First Spark Spectrum. S. Tolansky. *Roy. Soc., Proc.* 149A. *pp.* 269–281, *April* 1, 1935.—The fine structures of 42 lines of the first spark spectrum of iodine, in the region λλ6600–4500, have been measured by means of a silvered Fabry-Perot interferometer. Eleven classified lines have been analysed, and it is proved that the nuclear spin of iodine is 5/2. Fine-structure interval factors have been calculated for 10 terms belonging to the $5s^2\,5p^3\,6s$, $5s^2\,5p^3\,7s$, $5s^2\,5p^3\,6p$ electron configurations. A fine-structure perturbation effect has been found in one unclassified line. AUTHOR.

2108. Spectrum of Boron Fluoride. R. B. Dull. *Phys. Rev.* 47. *pp.* 458–460, *March* 15, 1935.—The spectrum of boron fluoride was photographed in the first order of a 21-foot concave grating. Three new bands were found in the ultra-violet, the structure of which appears to be similar to that of the third positive bands of CO. The visible bands, most of which were known previously, are unlike those in the ultra-violet, having a very diffuse appearance. AUTHOR.

2109. Infra-Red Absorption Spectra of Gaseous, Dissolved and Liquefied Ammonia. G. Costeanu, R. Freymann and A. Naherniac. *Comptes Rendus,* 200. *pp.* 819–822, *March* 4, 1935.—The third, fourth and fifth harmonic bands of NH_3 in the visible region have previously been investigated [see Abstract 438 (1932)] with gaseous, dissolved and liquefied ammonia. Using a photoelectric registering spectrometer already described [see Abstract 2039 (1934)] the authors extend this investigation to the infra-red second harmonic band near λ10320, which Lueg and Hedfeld photographed and analysed in gaseous NH_3. In passing from gaseous NH_3 at atmospheric temperature and pressure, to aqueous solutions of NH_3 of concentrations increasing step by step from 2 % to 50 %, and finally to liquefied NH_3 at –45° to –75° C., the tabulated observational data show systematic displacements towards lower frequencies. The same result is obtained with NH_3 solutions in methyl alcohol and in ethyl alcohol of increasing concentrations. These increasing displacements are in the same sense as those observed in visible bands and in the Raman spectrum, and are attributed to the increasing formation of polymers in dissolved and liquefied ammonia [see following Abstract]. W. J.

2110. Infra-Red Absorption Spectra of Derivatives of Ammonia. P. Job, Marie Freymann and R. Freymann. *Comptes Rendus,* 200. *pp.* 1043–1044, *March* 18, 1935.—Absorption spectra of ammonia and its substitution derivatives contain a strong band near 10400 Å. attributed to NH vibration. This band, previously recorded in ammonia (gaseous, dissolved or liquefied) [see preceding Abstract], aniline and diethylamine, is now measured in aqueous solutions of other substances containing NH_2, namely hydrazine, phenylhydrazine, ethylene diamine and urea. This absorption band is not given by aqueous solutions of compounds in which the N is tetra-coordinated such as the ammonium salts NH_4Cl, NH_4NO_3, $(NH_4)_2SO_4$, $CH_3COO(NH_4)$, $C_2O_4(NH_4)_2$, chlorhydrates of hydroxylamine and diaminophenol, and cobaltammines and cupriammines (which show only a very slight inflexion of the absorption curve near 10400 Å). The band at 10400 Å remains unaffected by the introduction of KCl into NH_3 solution, but disappears as NH_3 solution is neutralised by HCl. The infra-red spectrum of an aqueous solution of ammonia being quite different from that of an ammonium salt, the formula $NH_3 . nH_2O$ would appear to be preferable to NH_4OH. W. J.

2111. Intramolecular Isomerism and Infra-Red Absorption Spectra. J. Errera and P. Mollet. *Comptes Rendus*, 200. *pp.* 814–817, *March* 4, 1935.—The infra-red absorption spectra of phenol, *o*-chlorophenol and *m*- and *p*-hydroxybenzaldehyde (all observed for a pressure of 4 mm. Hg) contain an OH band near $\lambda 1 \cdot 51\mu$ and a CH band near $\lambda 1 \cdot 69\mu$. In phenol the OH band is displaced from $1 \cdot 54$ to $1 \cdot 49\mu$ as the temperature is raised from 60° to 120° C., while the CH band remains undisplaced [see Abstract 5042 (1934)]. In salicyclic aldehyde, the OH band is entirely absent. These observations are in accordance with Sidgwick's view that in salicylic aldehyde an internal isomerism (cyclisation) occurs, *i.e.*, there is a coordination co-valence or semi-polar bond between the O of the COH and the H of the OH, which is not the case in phenol. This cyclisation is possible but improbable in ortho-chlorophenol and impossible in the hydroxybenzaldehydes. It thus seems that the existence of cyclisation is indicated by the disappearance or large displacement of the OH band. W. J.

2112. Intramolecular Isomerism of α-Picoline Studied in the Remote Infra-Red. C. H. Cartwright and J. Errera. *Comptes Rendus*, 200. *pp.* 914–916, *March* 11, 1935.—The high value of the atomic polarisation of α-picoline has been regarded as an indication that a H atom of the methyl group is mobile and that this compound can exist in two modifications, one containing a tertiary N atom and a methyl group and the other an NH and a CH_2 group [see Abstract 3394 (1934)]. A study has now been made of the absorptions and reflecting powers of α- and β-picolines in the remote infra-red (52–152μ). The values of the coefficient of absorption, $n\alpha$, show marked increases as λ increases beyond 63μ, the dipoles then beginning to contribute to the polarisation; moreover, the variations of the coefficient of absorption are similar for the two compounds. Since, in β-picoline the distance between the nitrogen atom and the methyl group is too great to allow of tautomerism, these results furnish an argument against the existence of tautomeric forms of the α-isomeride. This conclusion is supported by the absence of an NH band at about $1 \cdot 55\mu$ in the near infra-red absorption spectrum of α-picoline. T. H. P.

2113. Absorption Spectra of Organo-Metallic Compounds. R. K. Asundi, C. M. B. Rao and R. Samuel. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 542–554, *Feb.*, 1935.—Absorption spectra of the vapours of $(CH_3)_2Hg$, $(C_2H_5)_2Hg$, $(C_2H_5)HgCl$, $(C_6H_5)_2Hg$, $(C_6H_5)HgCl$ and $(C_6H_5)_4Pb$ are recorded in the ultra-violet and Schumann (fluorspar) regions, and photometer curves obtained. The absorption is continuous in each case, but some maxima and minima are observed. In $(CH_3)_2Hg$, $(C_2H_5)_2Hg$, $(C_6H_5)_2Hg$ and $(C_6H_5)HgCl$ the long wave-length limits are interpreted as corresponding with the splitting of the C–H link giving rise to two unexcited radicals; in the other two compounds, the splitting is attributed to the Hg–Cl and C–Pb links. An attempt is also made to interpret the bands observed. C. B. A.

2114. Absorption Spectra of Acetylene, Ethylene and Ethane in the Far Ultra-Violet. W. C. Price. *Phys. Rev.* 47. *pp.* 444–452, *March* 15, 1935.—An absorption spectrum of acetylene in the region 1520 to 1050 Å has been found. It appears at very low pressures. The analysis was made by obtaining the spectrum of acetylene made from about 50 % heavy water. The small isotopic shifts of many bands revealed them to be vibrationless electronic transitions. These are arranged into two Rydberg series going to the same limit which corresponds to an ionisation potential of 11·35 volts. The upper levels of the two series are designated as $np\Sigma$ and $np\Pi$ levels. The excitation and ionisation is from the CC bond and only vibrations affecting this bond appear. The character of the vibrations present is deduced from the magnitude of the isotopic shifts. Strong predissociation occurs around 1520 Å. This yields a value of about 187 Cal. mole for the strength of the triple CC bond. A similar set of bands appear in ethylene in the region 1750 to 1200 Å. The bands are more diffuse than those in acetylene, and only one strong Rydberg series was discovered. The limit of the series corresponds to an ionisation potential of 10·41 volts. The vibrational analysis is similar to that in acetylene. The spectrum of ethane is extremely diffuse and no analysis of it could be made. It is concluded that, as in methane, all the upper states are unstable. AUTHOR.

2115. Structure of Ultra-Violet Absorption Bands of Acetylene. A. Ionesco. *Comptes Rendus,* 200. *pp.* 817–819, *March* 4, 1935.—Analyses of the infra-red absorption bands and the Raman bands [see Abstracts 461 (1931) and 674 (1934)] showed that the linear molecule HC–CH in its ground state $^1\Sigma^+_g$ has $I_0 = 23\cdot5 \times 10^{-40}$ gm. cm.^{2}, and rotational levels with statistical weights alternating in ratio 3 : 1, which is the same as in H_2. The ultra-violet absorption bands previously described by the author [see Abstract 5054 (1934)] have been photographed with a dispersion of about 0·6 Å/mm. in a quartz prism spectrograph (6m. focus) and found to have a simple two-branch (P and R) structure and the same alternating intensity ratio 3 : 1. Wave-numbers are tabulated for one band, $\lambda_{R\,\mathrm{head}} = 2256\cdot2$, $\nu_0 = 44292\cdot2$; the excited and ground states have $I_0 = 24\cdot21$ and $23\cdot92 \times 10^{-40}$ gm. cm.^{2} respectively. The electronic transition is probably $^1\Sigma \leftarrow {}^1\Sigma$. W. J.

2116. Ultra-Violet Absorption Spectrum of Methylamine. V. Henri and W. Lasareff. *Comptes Rendus,* 200. *pp.* 829–830, *March* 4, 1935.—The ultra-violet absorption spectrum of methylamine between 2529 and 1986 Å contains 45 rather wide bands (mean width = 60 cm.$^{-1}$) with a characteristic structure, some consisting of four or five components with a maximum in the centre and the others of three or four components with a sharp edge toward longer wave-lengths. The spectrum can be divided into two groups A and *a* which overlap and which are displaced relative to one another by 2050 cm.$^{-1}$. A, which covers shorter wave-lengths, is 100 to 1000 times stronger than *a*, and this ratio depends on the temperature. Each group subdivides into three overlapping sub-groups with a displacement of 650 cm.$^{-1}$ The frequencies 2050 and 650 cm.$^{-1}$ are attributed to the normal molecule, and a frequency of 1000 cm.$^{-1}$, also identified, to the activated molecule. On the basis of the similarity between 2050 cm.$^{-1}$ and the frequency 2069 cm.$^{-1}$ belonging to the $^2\Sigma$

state of the C = N radical, the formula $H_2C = NH_3$ is proposed for methylamine. C. B. A.

2117. Absorption Spectrum of Tetraphenylrubene. C. Dufraisse and M. Badoche. *Comptes Rendus*, 200. *pp.* 929–931, *March* 11, 1935. —The absorption spectrum of tetraphenyl 1–1′–3–3′–rubene is recorded for solutions in CS_2, ethyl iodide, chloroform, acetone, amyl alcohol, ethyl ether, butyl ether, amyl ether, dioxane, ethyl acetate, benzene, anisol, benzylalcohol, ethyl benzoate, nitrobenzene and pyridine. The absorption bands, without change of structure, and without deformation, undergo a regular displacement in wave-length, their position varying over 150 Å between solutions in ether and in CS_2. For a given solvent, however, Beer's law is obeyed. No relationship is found between displacement and refractive index of the solvent. The absorption spectra in mixtures, in various proportions, of ether and CS_2, and of acetone and nitrobenzene, are studied, and it is concluded that no interaction between solute and solvent occurs. C. B. A.

2118. Ultra-Violet Absorption Spectrum of Pyridine. V. Henri and P. Angenot. *Comptes Rendus*, 200. *pp.* 1032–1034, *March* 18, 1935. —Pyridine vapour exhibits a large number of absorption bands between 3100 and 2513 Å. Above 2600 Å these are sharp, but at shorter wavelengths they become diffuse and finally continuous, with photochemical decomposition. 226 of the bands have been measured. A series of 6 sharp intense bands is identified, with a separation of 540 cm.$^{-1}$ and a first term value $A_0^0 = 34769$ cm.$^{-1}$ With the help of three other frequencies, 600, 1029 and 1488 cm.$^{-1}$, the whole spectrum can then be broken up satisfactorily into regular series with a general formula

$$1/\lambda = 34{,}769 + 542\,\nu' - 600\,\nu''_1 - 1029\,\nu''_2 - 1488\,\nu''_3,$$

where $\nu' = 0, 2, 3, 4, \ldots 13$; $\nu''_1 = 0, 1, 2, \ldots 22$; $\nu''_2 = 0, 1, 2$; $\nu''_3 = 0, 1$. The most obvious frequency of 542 cm.$^{-1}$ is attributed to the active state of the molecule and the others to the normal molecule. They agree well with the infra-red and Raman values. C. B. A.

2119. Electronic Spectra of Polyatomic Molecules. Part I. Saturated Aldehydes. Part II. Acrolein. E. Eastwood and C. P. Snow. *Roy. Soc., Proc.* 149*A*. *pp.* 434–466, *April* 10, 1935.—*Part I.*—Saturated aldehydes and ketones have ultra-violet absorption systems at $\lambda\lambda$3500-2500 (maximum near λ2900) due to an electronic transition to an excited state 28,600 cm.$^{-1}$ above the ground state. Both states in each molecule pertain to the electronic structure of the $> C = O$, which is similar to that in formaldehyde, whose ground and excited states are given by Mulliken as $[---]\,[y - y]^2\,{}^1A$ and $[---]\,[y - y]\,[z - z]\,{}^1B_2$ respectively, where $[---]$ denotes $[y + y]^2\,[x + x]^2\,[z + z]^2$. The transition is not entirely localised in the $> C = O$ double bond but affects the adjacent atoms also. The formaldehyde system [see Abstract 663 (1934)] consists of a progression of strong bands separated by 1187 cm.$^{-1}$ with each of which is a set of weaker bands separated by 830 cm.$^{-1}$; these are the separations of the vibrational levels of the excited state, the first pertaining to vibration in $> C = O$ and the second to subsidiary vibrational levels. The λ2900 systems of six other saturated aldehydes and two ketones, examined in a small quartz spectrograph (Hilger E37) also consist of bands whose separation is attributed to vibrational levels of $> C = O$. In going up the aldehyde group the bands become more diffuse and their separations diminish at first and then become sensibly constant: $H \cdot CH{:}O$ 1187, $CH_3 \cdot CH{:}O$ 1053, $C_2H_5 \cdot CH{:}O$ 1023, $C_3H_7 \cdot CH{:}O$ 1027, $C_4H_9 \cdot CH{:}O$ 1023,

$C_6H_{13}\cdot CH{:}O$ 1021 cm.$^{-1}$ These for the excited state correspond to the vibrational frequency of 1700 cm.$^{-1}$ established for $> C = O$ in the ground state by infra-red absorption and Raman bands of these molecules. Higher-dispersion instruments (Hilger E1 quartz and 21 ft. grating first order) partially resolve some of the bands but afford no support for Schou's vibrational and rotational analyses in acetaldehyde. *Part II.*—The ultra-violet absorption spectrum of acrolein $CH_2 : CH\cdot CH : O$ is examined with dispersions up to 1·2 Å/mm. (second order of 21-ft. grating, and one band in fourth order) and columns of vapour at various pressures. In one system the chief bands degrade to red from edges at $\nu\nu$

(stronger bands)	25860*	27124*	28403	29687
(weaker bands)	26368*	27639	28893	30175 cm.$^{-1}$

having separations of about 1270 and 500 cm.$^{-1}$; other bands occur at $\nu\nu$ 25956*, 26510*, 26995*; and, with long columns of saturated vapour, faint diffuse bands are observed at $\nu\nu$ 25296*, 25542*, 25647*. In each of the bands marked by * a series of diffuse single lines $\nu_m = A + Bm + Cm^2$ (m = successive integers) is observed at the high-ν side of the edge of the continuum. The 1270 cm.$^{-1}$ frequency is attributed to $> C = O$ vibration in the excited state (like the 1187 cm.$^{-1}$ in formaldehyde) but this state is different in type from the excited state of the saturated aldehydes. For further interpretation of acrolein bands, the ultra-violet absorption bands of crotonaldehyde $CH_3\cdot CH : CH\cdot CH : O$ and glyoxal vapour $O : CH\cdot CH : O$ have been similarly examined. The former are diffuse and have only a separation of about 1200 cm.$^{-1}$, ascribed to $> C = O$ vibrations; the 500 cm.$^{-1}$ separation in acrolein is therefore ascribed to vibration of CH_2 about the $C = C$ double bond. The glyoxal bands have sharpness and other features in common with acrolein, whose line series appear to be sub-hands (Q branches) possibly due to rotation of the molecule about its axis of least I, and yield several different values of I for the ground state. Acrolein has two other systems near λλ 4060 and 2500, and therefore two excited states near 24,600 and 40,000 cm.$^{-1}$ besides that near 25,860 cm.$^{-1}$

W. J.

2120. Ultra-Violet Band Spectrum of MgH and MgD. A. Guntsch. *Zeits. f. Physik*, 93. 7–8. *pp.* 534–538, *Feb.* 7, 1935.—The following bands are analysed for the transitions $^2\Pi^* - {}^2\Sigma$; 0–1 and 1–2 of MgH, 0–0, 1–1 and 0–1 of MgD. The source was the quartz discharge tube previously described [see Abstract 1180 (1934)]. A mixture of hydrogen and deuterium was led through the tube, so that the bands of both MgH and MgD appeared together. Predissociation was observed in the bands of both molecules, and occurred in MgD for a lower energy-value.

A. C. M.

2121. $A^1\Pi$ State of CO. L. Gerö. *Zeits. f. Physik*, 93. 9–10. *pp.* 669–675, *Feb.* 14, 1935.—Develops a method for detecting perturbations in a band without reference to other bands of the system, even if the rotation structure appears otherwise unaffected. The method is applied to the Angström and Herzberg bands with the common end state $A\,^1\Pi$ for which the rotation constants $B_e = 1\cdot6113$ and $\alpha = 0\cdot0225$ cm^{-1}. are determined.

W. S. S.

2122. Predissociation in the Upper Level of the Second Positive Group of Nitrogen ($C^3\Pi$). D. Coster, E. W. van Dijk and A. J. Lameris. *Physica*, 2. *pp.* 267–272, *March*, 1935. *In English.*—With a discharge tube of quartz very high rotations in the bands of the second positive group of nitrogen were obtained. In the 0 → 0 band no predissociation could be observed, though rotations up to $J = 90$ were found. This fact contrary to the predissociation in the levels $v' = 2$, 3 and 4 may easily be explained. AUTHORS.

2123. Efficiency of Excitation of the Nitrogen First Positive Bands by Electron Impact. S. E. Williams. *Phys. Soc., Proc.* 47. *pp.* 420–423, *May* 1, 1935.—A determination has been made of an upper limit to the effective target area of the nitrogen molecule for excitation to the triplet levels by electron impact. Observations were made on the visible groups of the first positive system by the use of an electron tube previously described. By calibrating the plate with a lamp, the absolute emission of which was found in comparison with a black-body radiator, the rate of emission of quanta in each group was calculated, and with the aid of the radiometric analyses available was extended to the whole of the first positive system. The cross-sectional area, for excitation by electrons with energy of about 14 volts, is, in terms of the area of the first Bohr orbit, found to be 5×10^{-2}, with an estimated probable error of 35 %. AUTHOR.

2124. Band Spectrum of Beryllium Monoxide. A. Harvey and H. Bell. *Phys. Soc., Proc.* 47. *pp.* 415–419, *May* 1, 1935.—It is shown that certain band-heads previously unaccounted for in the ultra-violet spectrum of BeO can be fitted by means of the equation $\nu_h = 29753 \cdot 0 + 1083 \cdot 1 \, (v' + \frac{1}{2}) - 11 \cdot 1 \, (v' + \frac{1}{2})^2 - 1148 \cdot 7 \, (v' + \frac{1}{2}) + 11 \cdot 6 \, (v'' + \frac{1}{2})^2$. It is suggested that the final level of these bands is the same as the initial level of the near infra-red bands (*i.e.* a $^1\Pi$ level) and it is also suggested that both the ultra-violet BeO systems are of $^1\Pi \rightarrow {}^1\Pi$ type. AUTHORS.

2125. Band Spectrum of Vanadium Oxide. P. C. Mahanti. *Phys. Soc., Proc.* 47. *pp.* 433–445, *May* 1, 1935.—The spectrum of VO has been photographed under high dispersion. Experimental evidence confirming that the emitting molecule is VO has been secured. The vibrational analysis of the band system has been extended to $v' = 8$, and approximate values of the vibrational constants have been calculated from the new band-head data. The rotational structure-analysis of the bands (0, 1), (0, 0) and (1, 0) shows the presence of two R and two P branches with a short Q branch. The rotational constants of the molecule have been evaluated. It is suggested that the band system is due to a $^2\Delta \rightarrow {}^2\Delta$ transition. AUTHOR.

2126. Effective Rotation Temperature of the Negative Glow in Nitrogen. N. Thompson. *Phys. Soc., Proc.* 47. *pp.* 413–414, *May* 1, 1935.—A summary is given of the results of further determinations of the effective rotation temperature produced when a discharge tube is maintained at a high temperature by external heating, and the form of the relation between the two temperatures is discussed in the light of the revised results. [See Abstract 2517 (1934).] AUTHOR.

2127. Potential Formulæ in Diatomic Molecules. W. Lotmar. *Zeits. f. Physik*, 93. 7–8. *pp.* 528–533, *Feb.* 7, 1935.—Expressions for ten potentials containing three constants enable the interaction between vibration and rotation to be allowed for. The shape of the potential against interatomic distance curve is considered, using the potential functions of Morse $[(\mathrm{V}\,(r) = \mathrm{D}\,(1 - e^{-a(r-r_e)})^2]$ of Rosen and Morse $\left[\mathrm{V}\left(\frac{r}{d}\right) = \mathrm{A}\tan^2\left(\frac{r}{d}\right) - \mathrm{C}\sec^2\left(\frac{r}{d}\right)\right]$ and of Pöschl and Teller $\left[\mathrm{V}\left(\frac{r}{d}\right) = \mathrm{M}\right.$

$\mathrm{cosec}^2\left(\frac{r}{d}\right) - \mathrm{N}\ \sec^2\left(\frac{r}{d}\right)\Big]$. The second gives a more symmetrical curve than the Morse function does, while the last gives a less symmetrical curve. For most cases the second potential function is recommended, for some (*e.g.* the normal state of H_2) the last is recommended. Curves are given for HgH, CdH and O_2 showing that the Rosen-Morse function is nearer the truth than the Morse function. A. C. M.

2128. Polarisability of the Hydrogen Molecule. G. Steensholt. *Zeits. f. Physik,* 93. 9–10. *pp.* 620–623, *Feb.* 14, 1935.—Mathematical. W. R. A.

2129. Interrelation of the Equilibrium Nuclear Distance with other Molecular Constants for Diatomic Molecules. R. A. Newing. *Phil. Mag.* 19. *pp.* 759–767, *April,* 1935.—Certain data from band-spectra are shown to lead to a general relation of the form $r_e = r_e\,(w_e, x_e, \mathrm{D}_e, \mu)$, between the nuclear distance, r_e, and certain other molecular constants. Empirical relations have been set up in the form $r_e = r_e\,(w_e)$, and $r_e = r_e\,(w_e, \mu)$, and are therefore of a less general type. To establish the empirical relations on a theoretical basis it is necessary to carry out an investigation into the general properties of the potential curves of diatomic molecules. Certain suggestions are made as to the type of procedure that may prove sufficient for the purpose, but the detailed analysis will appear in a subsequent paper. AUTHOR.

2130. Relation between Molecular Spectrum and Atomic Rings of Electrons. H. Deslandres. *Comptes Rendus,* 200. *pp.* 603–607, *Feb.* 18, 1935.—An empirical formula was previously described [see Abstract 1159 (1935)] connecting molecular frequencies with numbers of electrons in the rings of atoms combined in the molecule. Further examples are considered in this paper. A. C. M.

2131. Rotational Energy of Polyatomic Molecules. J. H. van Vleck. *Phys. Rev.* 47. *pp.* 487–494, *March* 15, 1935.—It is shown that the quantised energy of a polyatomic molecule is approximately separable into the internal electronic and vibrational energy plus the rotational energy with the latter determined by solving the conventional problem of the rigid asymmetrical top. Because of the large oscillating terms in the Hamiltonian function due to interaction between vibration and rotation, this conclusion is not as obvious as it sounds, and seemed, if anything, to be contradicted by Eckart's recent investigation on the choice of a reference frame [see Abstract 4198 (1934)]. The discrepancy, however, disappears when a second order perturbation calculation is made with Eckart's coordinates. AUTHOR.

2132. Rotating Axes and Polyatomic Molecules. C. Eckart. *Phys. Rev.* 47. *pp.* 552–558, *April* 1, 1935.—The theory of small vibrations when the potential energy is invariant under the rotation-displacement group is developed. The results are compared with the Brester-Wigner theory of the normal coordinates, and it is shown that the use of these coordinates implies the use of a particular (normal) system of rotating axes whose construction is given. It is shown that when the motion of a normal molecule is referred to these axes, those terms of the Hamiltonian which are linear in the angular momenta will be especially small and of the same order of magnitude as the quadratic terms (Casimir's condition). When the amplitude of one or more of the normal vibrations becomes large, this is no longer true of the normal axes; this will always be the case when one of the normal frequencies is small compared to the others, as has been noted by other writers. The normal axes are not the principal axes of inertia of the instantaneous configuration of the system, and certain conclusions recently published by the author [see Abstract 4198 (1934)] are wrong for that reason. AUTHOR.

2133. Normal Vibration Frequencies of NH_3, PH_3 and AsH_3. J. B. Howard. *J. Chem. Phys.* 3. *pp.* 207–211, *April*, 1935.—It is shown that the assumption of valence forces for NH_3, PH_3, and AsH_3 leads to the conclusion that the high frequency, degenerate normal vibration, although theoretically active, does not appear as a fundamental in the infra-red spectra of these compounds. This conclusion follows from the fact that the remaining three fundamentals, all of which have been observed, can be accounted for satisfactorily with proper values of the two constants of the potential function for valence forces. The values calculated for this absent frequency with the same force-constants are 3450 cm^{-1}, 2340 cm^{-1} and 2125 cm^{-1} for NH_3, PH_3 and AsH_3, respectively. The frequency for NH_3 may be fixed more precisely at 3470 cm^{-1} if we interpret the 4417 cm^{-1} band as a combination band involving this frequency and the 950 cm^{-1} frequency. Other evidence is given in support of a value for the frequency in the neighbourhood of 3450 cm^{-1}. There is, however, the difficulty of explaining why the predicted frequencies are not observed. The 4417 cm^{-1} band is probably to be ascribed to the fourth fundamental in case this fundamental does actually appear. If this is the case, then there is an extreme departure from valence forces in NH_3 and probably likewise in PH_3 and AsH_3. Frequencies are computed for NH_2D, ND_2H and ND_3 to provide a means of testing the value predicted upon the assumption of valence forces for the fourth fundamental in NH_3. AUTHOR.

2134. Energy Distributions in the Ultra-Violet Continua of Molecular Hydrogen and the Positive Crater of the Carbon Arc. G. Déjardin and (Miss) R. Schwégler. *Rev. d' Optique*, 13. *pp.* 313–330, *Oct.*, and *pp.* 353–374, *Nov.*, 1934.—The energy : wave-length curves for these two continuous spectra are obtained over the range λλ3400–2100 by means of an ordinary potassium-argon photoelectric cell with a fluorescent coating (a mixture of sodium salicylate and dextrin) 0·5 to 1 mm. thick on the outer surface of its glass bulb—a device previously used, *e.g.*, by Duboulez, whose observations are now confirmed and extended. The earlier part of the paper records results of preliminary investigations, including the sensitivity curves of the photo-cells and the transmission curves of the quartz window of the hydrogen tube (Dunoyer-Chalonge pattern), the quartz-fluorite projection lens and the two quartz monochromators used. For hydrogen tubes, both before and after prolonged use (which results in slight loss of transparency of the quartz window below λ2500), and with currents of about 25, 50 and 100 mA, the energy curves of the continuum rise steadily, without either a maximum or an inflexion, with diminishing λ throughout the range investigated. For the positive crater of a carbon arc with 10 amperes at 65 V the energy curve almost coincides with that of a black body at 3800° K, but also shows relatively strong lines below λ2500. Between λλ2330 and 2290 the crater spectrum also contains a band recently described and analysed by Hori [see Abstract 2501 (1934)] and attributed to the molecule C_3. W. J.

2135. Absorption Spectrum of Germane. H. E. Mahneke and W. A. Noyes, Jr. *Am. Chem. Soc., J.* 57. *pp.* 456–458, *March,* 1935.—Germane shows no banded absorption at wave-lengths longer than 1550 Å. It does show continuous absorption extending from about 1700 Å. to shorter wave-lengths. Attempts were made to determine the nature of the primary step in photochemical decomposition of germane. Experiments show that failure in these attempts may be due to the fact that hydrogen atoms react readily with germane and would not have a long independent existence. AUTHORS.

2136. Excitation Spectra of the Luminescence of Solid Solutions of Rhoduline. S. I. Goloub. *Phys. Zeits. d. Sowjetunion,* 7. 1. *pp.* 49–57, 1935. *In French.*—A description is given of a new method of studying the excitation spectra of luminescent substances. In the case of solid solutions of rhoduline in sugar it is shown that the excitation spectra of fluorescence and phosphorescence are identical. L. A. W.

2137. Quadratic Zeeman Effect. G. Racah. *N. Cimento,* 11. *pp.* 723–724, *Dec.,* 1934.—It is shown that the theory of the quadratic Zeeman effect according to Dirac's relativistic wave equation of the electron, must yield the same result as the earlier non-relativistic Schrödinger theory which has received experimental confirmation in the case of the principal series of sodium. W. S. S.

2138. Deep Configurations of Cobalt. H. H. Marvin. *Phys. Rev.* 47. *pp.* 521–526, *April* 1, 1935.—The energy matrix of electrostatic and magnetic spin-orbit interaction is set up for d^7s^2, d^8s and d^9, taking into account the mutual interactions of these configurations. The secular equations are fitted to the deep configurations of CoI, separately, by selecting suitable values for the interaction parameters. The uncertainty existing concerning the assignments of a^2D, a^2G and b^2D is removed. The g-factors for the Zeeman effect in intermediate coupling are calculated for comparison with experimental values [see following Abstract]. The mutual interactions of $3d^84s$ with $3d^74s^2$ and $3d^9$ are found to be relatively insignificant. The secular equations are fitted to $3d^74s^2$ and $3d^9$ together, tentatively, in order to observe the effect of mutual interaction upon the values of certain terms which have not yet been discovered, and upon the g-factors. The interaction parameters are compared with those of the deep configurations of Ni I. AUTHOR.

2139. Zeeman Effect in the Arc Spectrum of Cobalt. F. L. Roth and P. F. Bartunek. *Phys. Rev.* 47. *pp.* 526–531, *April* 1, 1935.—Zeeman patterns for 151 lines in the range λ3200 to λ6500 are measured and g-factors for 100 terms are determined. All the experimental g-factors are compared with their theoretical values for LS coupling and those for the deep even terms are compared with theoretical values for intermediate coupling. The experimental values for the multiplets, b^4P, a^2D, m^2D°, y^4F° and m^2P° deviate rather widely from the theoretical values. The Zeeman patterns indicate changes in classifications for λ4549·67 and λ6450·24 and decide the quantum numbers for two incompletely analysed terms [see preceding Abstract.] AUTHORS.

2140. Stark Effect in the Molecular Spectra of Nitrogen, Carbon Monoxide and Hydrogen. W. Rave. *Zeits. f. Physik,* 94. 1–2. *pp.* 72–84, *March* 12, 1935.—A search is made for Stark effects in band spectra. Neither displacements nor separations of lines are observed in the bands 4278 and 3914 Å. of N_2^+, and the Comet bands of CO^+ with field strengths up to 280 kV/cm. and a dispersion of from 10 Å to 22 Å per mm. The

Stark effect of the Fulcher bands of H is measured quantitatively with fields up to 664 kV/cm.; the displacements can be represented by the formula $\Delta\nu = aF + bF^2$ where F is the field strength. The effect appears to originate in the Σ term of the bands, the Π term being undisturbed by the field. T. E. K.

2141. Distribution of Intensity in Rotational Raman Spectra of Gases. S. Bhagavantam and A. V. Rao. *Indian Acad. Sci., Proc.* 1*A. pp.* 419–424, *Jan.*, 1935.—The rotational Raman effect in gases can be satisfactorily accounted for theoretically. This is not so for liquids. The matter is investigated by starting with a gas and compressing it in stages at a temperature below the critical temperature. Carbon dioxide and nitrous oxide were examined. At high pressures, although the scattering material was still gaseous, the maxima of intensity in the " wing " accompanying the Rayleigh line was absent just as it is in the case of a liquid. A. C. M.

2142. Raman Effect and Free Rotation. B. Trumpy. *Zeits. f. Physik*, 93. 9–10. *pp.* 624–628, *Feb.* 14, 1935.—An extension of earlier work [see Abstract 4213 (1934)]. The depolarisations in the Raman spectra of molecules of the type $X_2YC{-}CYX_2$ are measured and discussed on the basis of Placzek's theory of polarisability and with regard to free rotation in the molecule. 1–2 dichlorethane, 1–2 dibromethane, and 1–2 tetrachlorethane exist in the *trans* form. W. R. A.

2143. Raman Spectra of Sulphuric, Nitric, and Nitrosyl-Sulphuric Acids. W. R. Angus and A. H. Leckie. *Roy. Soc., Proc.* 149*A. pp.* 327–340, *April* 1, 1935.—Raman spectra are recorded for concentrated sulphuric and nitric acids, for solutions of $HNSO_5$ in sulphuric acid and for solid $HNSO_5$. By observing the spectra of $HNSO_5$ in various concentrations of H_2SO_4 it is concluded that in solutions of $HNSO_5$ in sulphuric acid containing more than 60 % H_2SO_4 the hydrolysis of $HNSO_5$ is incomplete. The spectra of $HNSO_5$, both in solution and in the solid state, are characterised by a prominent displacement of 1045 cm.$^{-1}$ which is assigned to the HSO_4^- ion. Another very prominent displacement of 2340 cm.$^{-1}$ for solutions and 2311 cm.$^{-1}$ for the solid state is shown, by analogy from band spectral data for isoelectronic groups, to arise from the group NO^+. Of the different molecular structures reviewed, only $[HOSO_3]'[NO]^{\cdot}$, nitrosyl sulphate, is in accord with observed data.

AUTHORS.

***2144. Luminous Glow-Discharge Tube for the Spectroscopic Investigation of Small Amounts of Mixtures. H. Schüler and H. Gollnow.** *Zeits. f. Physik*, 93. 9–10. *pp.* 611–619, *Feb.* 14, 1935.—A full description of apparatus giving a means of obtaining spectrograms of small amounts of substances (1 mg.), independent of the state of chemical combination of the element investigated. The use of the apparatus for the investigation of hyperfine structure with some rare earths is mentioned, together with the detection of new elements in nuclear transformations and artificial radioactivity. W. R. A.

2145. Reversal of Neon Lines. H. Nagaoka and T. Mishima. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 554. *pp.* 136–155, *Feb.*, 1935. *In English.*—The reversal of neon lines (6507, 6402, 6266, 6143, 6096 and 5852 Å) has been investigated and the interference fringes measured micorphotometrically. Decrease in pressure from 25 mm. to 3 mm. leads to increased reversal. Observations are recorded at liquid-air temperature and at ordinary temperature and it is found that at higher

temperatures the boundary becomes more vague. By increasing the capillary bore of the gas tube the reversal is diminished. The reversal produced by a.c. and d.c. excitation is dependent on the current density. No adequate explanation can be advanced to explain these phonemena.
W. R. A.

See also Abstracts 1907, 1910, 1969, 1971, 2025, 2057, 2076, 2077, 2087, 2209.

VELOCITY OF LIGHT.

2146. Constancy of Velocity of Light. R. J. Kennedy. *Phys. Rev.* 47. *pp.* 533–535, *April* 1, 1935.—It is shown that hypotheses of variable velocity of light of the sort advanced by several recent writers are in conflict with experimental and astronomical data which greatly outweigh in probability the data correlated by these authors. AUTHOR.

See also Abstract 2058.

VISION.

2147. Optical Illusions. T. Terada, R. Yamamoto and T. Watanabe. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 552. *pp.* 109–121, *Feb.*, 1935. *In English.*—Gives some quantitative observations on perspective illusions obtained with coloured papers pasted on black or white backgrounds. The effects are explained by eccentricity of the pupil opening. Also describes effects observed when viewing an irregular pattern through a rectangular wire lattice. Lines in the pattern at 45° to the lattice lines appear accentuated. On viewing the lattice, faintly illuminated from behind, against a dark background a region of flickering luminous spots, whose extent depends on the mesh of the lattice, can be observed. W. S. S.

2148. Measurement of Visual Acuity by Means of Interference Fringes. Y. le Grand. *Comptes Rendus*, 200. *pp.* 490–491, *Feb.* 4, 1935.—By viewing a distant light point through two small apertures placed at the cornea, interference fringes are seen which can be compressed until they are no longer resolvable, by bringing the two apertures nearer together. In this way the factors of diffraction and refractive irregularities of the eye are eliminated and the visual acuity associated with retinal structure is arrived at. Comparison is made with the acuity determined in the usual manner employing an external fringe system duplicating that formed on the retina in the first experiment. At high brightnesses the two methods give the same acuity but at lower brightnesses or with diminished contrast in the fringes the imperfections of the eye cause the acuity to be greater for the internal fringe system. It is concluded that at high brightnesses and contrasts acuity is limited by the retinal structure, at low brightnesses and contrasts by the optics of the eye. W. S. S.

2149. Disadvantage of Didymium in Eye-Glasses. A. Polack. *Comptes Rendus*, 200. *pp.* 488–490, *Feb.* 4, 1935.—Owing to the chromatic aberrations of the eye accommodation cannot be correct for the whole spectrum, but by calculating the distribution of luminous intensity in the circle of diffusion of the retinal image of a point, it is apparent that adjustment to clear seeing must correspond to accommodation for the yellow rays. Since didymium glass absorbs the yellow rays, its use for spectacles modifies adversely the conditions for distinct vision. High absorption in the ultra-violet is actually due to the associated cerium and where complete elimination of the ultra-violet is necessary cerium glass freed from didymium should be used. W. S. S.

X-RAYS.

2150. Distribution of Characteristic X-Rays from a Single-Crystal Antikathode. W. Kossel, V. Loeck and H. Voges. *Zeits. f. Physik,* 94. 1–2. *pp.* 139–144, *March* 12, 1935.—When a single crystal is used as antikathode the characteristic X-rays emitted are diffracted within the crystal and hence are emitted in different directions. A spherical single crystal of copper is used in the present instance and a photographic film is placed between the crystal and the kathode, a hole being cut in the film and film holder to allow the electrons to pass through. The traces of the emitted Cu-Kα X-rays are obtained on the film for various settings of the crystal. Precautions are taken that the film holder itself shall not give rise to any X-rays. J. T.

2151. Atom Form-Factors. B. v. S. Nagy. *Zeits. f. Physik,* 94. 3–4. *pp.* 229–230, *March* 19, 1935.—Several corrections and additions are given to a previous paper by the author [see Abstract 4605 (1934)]. The F-values of Cs are given in full and may be used for calculating those of any neutral atom. J. T.

2152. Atmospheric Absorption of Extra-Terrestrial X-Rays. E. A. W. Müller. *Zeits. f. Astrophysik,* 10. *pp.* 52–55, *March* 13, 1935.—The author has computed curves showing the absorption of different wave-lengths for the various components of the atmosphere. Radiation of $\lambda < 0{\cdot}4$ Å might be detected at the highest attainable altitudes. T. L. M.

2153. Radiative Damping and Width of X-Ray Lines. J. A. Prins. *Physica,* 2. *pp.* 231–238, *March,* 1935. *In German.*—The classical formula for the half-width of spectral lines due to radiative damping is modified by quantum theory; the modified formula is used for calculating fluorescence yields from observed line widths in the soft and ultra-soft X-region. It is found that radiative damping (coupling of the electron with the waves) causes a half-width of 0·02 to 0·2 X units. This effect is the chief cause of broadening for the heavy elements. In all other cases the Auger effect is the most responsible for broadening (electrostatic coupling between electrons). This gives a broadening of 0·5 to 10 volts. Until right into the very soft regions other causes hardly count. In certain cases magnetic coupling occurs and also "contact" effects (influence of surroundings in uncompleted shells). J. E.

2154. M-Series of Element 91-Protactinium. W. C. Pierce and A. V. Grosse. *Phys. Rev.* 47. *pp.* 532–533, *April* 1, 1935.—Fourteen lines of the M series have been identified and their wave-length determined. The corresponding M lines for uranium were measured and Lindberg's values confirmed. AUTHORS.

2155. X-Ray Examination of Active Charcoal and Soot. D. Wilm and U. Hofmann. *Kolloid. Zeits.* 70. *pp.* 21–24, *Jan.,* 1935.—Details are given of determinations of particle sizes in active charcoal and soot, from measurements of the half-value breadths of X-ray interference lines. J. T.

2156. X-Ray Laue Diagrams of Vibrating Crystals. F. Klauer. *Phys. Zeits.* 36. *pp.* 208–211, *March* 15, 1935.—X-ray Laue diagrams of a quartz crystal vibrating piezoelectrically are obtained, and are analogous to those obtained by Schaefer and Bergmann with light waves [see Abstract 3666 (1934)]. An investigation is made of the influence of the frequency of vibration, and the direction of the X-ray beam. J. T.

2157. X-Ray Reflectivity and Resolving Power of Quartz Crystals. L. G. Parratt. *Rev. Sci. Instruments*, 6. *pp.* 113–115, *April*, 1935.—The reflectivity and resolving power of the etched (110) face of quartz is measured for eleven wave-lengths ranging from Ag-$K\alpha$ to Si-$K\alpha$. The (110) face is chosen on account of its relatively large grating space, which makes it possible to study wave-lengths in the range 5 to 8 Å. The resolving power is found to be greater than that of calcite crystals for wave-lengths greater than 3 Å. J. T.

***2158. Absolute Determination of the Wave-Lengths of the Al $K\alpha_{1,2}$-Line by the Plane Grating Method. E. Bäcklin.** *Zeits. f. Physik*, 93. 7–8. *pp.* 450–463, *Feb.* 7, 1935.—A modified plane grating method for determining X-ray wave-lengths, which gives much improved precision, is described. The value now obtained for the wave-length of the Al $K\alpha_{1,2}$ line, 8·3395 Å, lies inside the probable error of earlier determinations. Coupled with the data from the crystal method, this value leads to a value $e = 4{\cdot}805 \times 10^{-10}$ e.s.u. for the electronic charge. C. B. A.

2159. Fluorescent Yield for Characteristic K-Radiation. E. Arends. *Ann. d. Physik*, 22. 3. *pp.* 281–310, *March*, 1935.—A critical survey is given of previous work on the efficiency of production of fluorescent X-rays. An ionisation method is described for the determination of the fluorescent yield u. The value of u is about 0·2 for elements of low atomic number and about 0·8 for elements of which the atomic number is in the neighbourhood of 50. Values of u are obtained for Fe, Ni, Cu, Zn, Se, Mo, Ag and Sn. They are in good agreement with those found by Stockmeyer, Compton and Harms. The accuracy claimed is 1 % if the atomic number is between 25 and 35, and 3 % if it is between 35 and 50. J. T.

2160. Quantitative Determination of Unsharpness Due to Intensifying Screens. P. Wiest. *Zeits. f. techn. Physik*, 16. 2. *pp.* 53–56, 1935.—The method used for determining the "unsharpness" (defined in the paper) produced by intensifying screens is described. The results of the study of three different screens are given and discussed. W. E. P.

***2161. Luminescent Properties of Zinc Sulphide in Relation to X-Rays. L. Levy and D. W. West.** *Brit. J. of Radiology*, 8. *pp.* 184–195, *March*, 1935.—ZnS can be prepared so as to exhibit more brilliant fluorescence and phosphorescence than any other substance. The phosphorescence has been a disadvantage as regards X-ray screens and the authors have at last managed to eliminate it. They have found that a trace of nickel (about 1 in 2×10^6) is sufficient to reduce the afterglow to negligible amount. The brilliancy of the new screens is over 4 times that of the best cadmium sulphate screens. If a trace of copper is added the screen stores up a latent image which may be brought out at a later time by warming up. The new screens find application as intensifying screens in X-ray spectroscopy, reducing the exposure to the order of one twentieth. J. E.

See also Abstracts 1982, 2055, 2288, 2289, 2290, 2293.

HEAT.

CALORIMETRY.

2162. Mean Specific Heat of Glass at High Temperatures. C. W. Parmelee and A. E. Badger. *Univ. of Illinois Eng. Exp. Sta., Bull.* 271. [24 *pp.*], *Dec.*, 1934.—The paper describes measurements of the mean specific heat of nine different types of commercial glass between temperatures of the order of 1000° C. and room-temperature. Mercury was used as the calorimetric liquid and the apparatus was calibrated using silica glass as a standard of specific heat. L. G. C.

2163. Anomaly in the Specific Heat of Anhydrous Ferrous Chloride. O. N. Trapeznikowa and L. W. Schubnikow. *Phys. Zeits. d. Sowjetunion,* 7. 1. *pp.* 66–81, 1935. *In German.*—A description is given of a calorimeter suitable for the measurement of specific heats of powdered substances at low temperatures. The specific heat of anhydrous $FeCl_2$ is measured in the temperature range from 16 to 120° Abs. and a discontinuity is found at 23·50° Abs. L. A. W.

2164. Measurements of Specific Heats at Low Temperatures. F. Simon and R. C. Swain. *Zeits. f. phys. Chem.* 28. *Abt. B.* 3. *pp.* 189–198, 1935.—The specific heat of Li was measured between 15° K. and room-temperature and it was found that the experimental curve cannot be interpreted in terms of a simple Debye function. It can, however, be expressed as the sum of a Debye function and a Schottky function, the former having a characteristic temperature of 505° and the latter a maximum at about 85° K. The specific heats of iron, calcite and corundum were also measured from the temperature of liquid hydrogen upwards. In addition, measurements were made of the specific heat of activated charcoal both gas-free and with a layer of adsorbed argon, and it was found that argon behaved as a two-dimensional gas; the specific heat began to fall at 60° K. and practically disappeared at 12° K. The apparatus was essentially the same as that of Cristescu and Simon [see Abstract 2546 (1934)]. L. G. C.

2165. Heat Capacities of the Oxides of Strontium and Barium at Low Temperatures. C. T. Anderson. *Am. Chem. Soc., J.* 57. *pp.* 429–431, *March,* 1935.—The heat capacities of SrO and BaO from about 55 to 300° K. have been determined and their corresponding entropies calculated as 13·0 and 16·8 respectively. AUTHOR.

2166. Specific Heat and Electronic Activation in Crystals. J. E. Ahlberg and S. Freed. *Am. Chem. Soc., J.* 57. *pp.* 431–437, *March,* 1935.—It is shown possible among the rare earths to determine experimentally the portion of the specific heat associated with electronic transitions in crystals. The heat capacities of $Sm_2(SO_4)_3 \cdot 8H_2O$ were determined at temperatures from 17 to 295° K., and the data are reported. These are compared with the heat capacities of $Gd_2(SO_4)_3 \cdot 8H_2O$ over the same temperature range [see following Abstract]. The quantitative agreement between the observed and computed electronic specific heats is found satisfactory. The statistical weights for the levels in the basic multiplet were found to be equal to each other. AUTHORS.

2167. Heat Capacity of $Gd_2(SO_4)_3\cdot 8H_2O$ from 16 to 300° Abs. J. E. Ahlberg and C. W. Clark. *Am. Chem. Soc., J.* 57. *pp.* 437–438, *March,* 1935.—The specific heat of $Gd_2(SO_4)_3\cdot 8H_2O$ has been determined from 16 to 300° Abs. [See preceding Abstract.] AUTHORS.

2168. Thermal Measurements on Heavy Water. E. Bartholomé and K. Clusius. *Zeits. f. phys. Chem.* 28. *Abt.B.* 3. *pp.* 167–177, 1935. —By means of a Bunsen ice calorimeter the heats of melting and sublimation of D_2O have been measured, as well as the mean specific heat between — 20° and 0° and between 0° and 18°. Calculated from the melting point 3·8°, the molecular heat of fusion is 1522 cal. and the molecular heat of sublimation 12631 cal.; the molecular weight of D_2O is taken as 20·027. Hence the heat of sublimation is 3·8 %, and the heat of fusion 6·1 % higher than the corresponding values for water at 0°C. These differences depend on differences between the intermolecular zero-point energy with the two kinds of water. The specific heats of D_2O and H_2O agree within the limits of experimental error. The vapour pressure of heavy ice is 3·65 mm. of mercury at 0°C. and 5·06 mm. at the triple point. T. H. P.

2169. Molecular Latent Heats. J. D. Huffington. *Phil. Mag.* 19. *pp.* 836–840, *April,* 1935.—It is shown that if x denote the work done in producing the observed decrease in volume in a condensation at temperature θ, $x/\theta = R\log(v_1/v_2)$, and is more constant than Trouton's ratio, C. A phase-change is a coordinated phenomenon involving interactions of all the molecules, and it is suggested that when a phase-change occurs the " structure " of the fluid is the same for all substances. It is shown that, in the case of 21 substances, good agreement between experimental and calculated values of C is obtained if C is written in the form $C = 1\cdot 20 + 0\cdot 00151\ (L/\theta)^2$. J. S. G. T.

CONDUCTION.

2170. Problem in Conduction. L. B. Snoddy. *Physics,* 6. *pp.* 139–140, *April,* 1935.—The expression for the temperature distribution in a semi-infinite bar with heat supplied to the surface $x = 0$ at a rate given by $H = kt^n (n = 0, 1, 2 \cdots)$ is derived, assuming no radiation to the surrounding medium and an initial temperature of zero. Curves are given which enable the distribution in a bar of any material to be readily computed for $n = 0$ and $n = 1$. The solution serves equally well to determine the voltage variation in a semi-infinite non-inductive cable with entering current proportional to t^n provided the heat constants are replaced by the appropriate electrical parameters. AUTHOR.

2171. Thermal Conductivity of Polyatomic Gases. A. R. Ubbelohde. *J. Chem. Phys.* 3. *pp.* 219–223, *April,* 1935.—Reasons are given for supposing that the thermal conductivity of polyatomic gases should not be independent of pressure. A calculation is made for CO_2, and the results suggest that a portion of the specific heat at 0° C. has a relaxation constant considerably less than 10^6 if the discrepancy between experimental and theoretical values of thermal conductivity is due to restrictions on the energy exchange between molecules. When such effects are present, determinations using parallel plates give a more reliable result than those using a vertical wire. AUTHOR.

DILATATION.

See Abstracts 1919, 2184.

MELTING AND BOILING POINTS.

2172. Refrigeration of Water by Fractional Evaporation. P. Chambadal. *Comptes Rendus,* 200. *pp.* 727–730, *Feb.* 25, 1935.—Expressions are deduced for the energy transfers accompanying refrigeration by means of single and multi-stage evaporators. For the limiting case when an infinite number of stages are used to cool water from T_1 to T_2° Abs. it is shown that the energy absorbed by unit weight of water at the lower temperature is equal to half of that absorbed in the case of a single evaporator and given up by unit weight of the warm water. The expression $q = (T_1 - T_2)^2 \, (0\cdot001784 + 0\cdot0018/(n - 0\cdot0236))$ represents the energy absorbed in cal./kg. of warm water, n being the number of stages. R. W. P.

2173. Distillation. *Indust. and Engin. Chem.* 27. *pp.* 250–272, *March,* 1935.—" Separation of Water from Acetic Acid by Azeotropic Distillation " by **D. F. Othmer** (*pp.* 250–255).—As a means of separating acetic acid from pyroligneous acid, the azeotropic method is characterised by simplicity and minimum numbers of pieces of equipment and operations, minimum size and hence cost of the plant units, and low steam consumption. These advantages become more pronounced when the raw material consists of the relatively strong solutions constituting the precipitation liquors from cellulose acetate manufacture. The use of special " opposed-tangentional " slot bubbler caps ensures highly efficient vapour-liquid contact on the plates of the distilling column and allows of a reduction of 15 to 25 % in the number of such plates.

" Distillation and Absorption in Packed Columns " by **T. H. Chilton** and **A. P. Colburn** (*pp.* 255–260).—The proposal is made that the difficulty of separation in a packed column be expressed—instead of in terms of the number of theoretical plates—as the number of " transfer units," defined, in the case of distillation, by the expression $\int_{p_1}^{p_2} \frac{dp}{\Delta p}$. The efficiency of a column would then be expressed as the height of a transfer unit (H.T.U.) instead of as the height equivalent to a theoretical plate (H.E.T.P.). The values so obtained are related directly to coefficients for the transfer of material by diffusion, but the calculation of the height of column necessary to effect a given separation is made more convenient by the use of the transfer unit concept. It is shown that, for many cases of distillation, the H.E.T.P. and the H.T.U. are nearly identical, but that there may be large differences between them in the case of certain absorption problems.

" New Design Calculation for Multi-Component Rectification " by **E. R. Gilliland** (*pp.* 260–265).—In the method described for the calculation of the design of plant for the separation by distillation of the various constituents of a multi-component mixture, the calculations are based on the use of relative volatility and relative operability of the components in the mixtures. The procedure is rapid and simple and, for the condition of infinite reflux, the calculation reduces to Underwood's modification of Fenske's relative volatility system. For the case in which separation between adjacent components is not relatively complete, the determination of suitable design conditions is greatly facilitated by such calculations. The applicability of the method is illustrated by examples.

"Entrainment in Plate Columns" by **T. K. Sherwood** and **F. J. Jenny** (*pp.* 265–272).—New experimental data are recorded on entrainment in a bubbler cap column in which air and water were used. The results show clearly the effects of gas velocity, plate spacing, and liquid level. An effect due to slot velocity as well as to superficial velocity is apparent. The analysis given of the effect of entrainment on column performance includes a treatment of the effect of the entrainment on the fractionation efficiency and on the appearance in the distillate of non-volatile impurity. Illustrative calculations show that, in most ordinary cases, the effect of the entrainment of less than 0·1 mol of liquid per mol of vapour is negligible.

"Effect of Entrainment on Plate Efficiency in Rectification" by **F. H. Rhodes** (*p.* 272).—Certain points briefly dealt with previously (*Indust. and Engin. Chem.* 26. *p.* 1333, 1934) are discussed at greater length. T. H. P.

See also Abstracts **1913, 1955.**

TEMPERATURE, MEASUREMENT OF.

***2174. Standard Tables for Chromel-Alumel Thermocouples. W. F. Roeser, A. I. Dahl. and G. J. Gowens.** *Bureau of Standards, J. of Research,* 14. *pp.* 239–246, *March,* 1935.—Tables have been prepared giving the thermal e.m.f. of chromel P *vs.* alumel, chromel P *vs.* platinum, and alumel *vs.* platinum at various temperatures in the range −310 to 2,500° F. The values in the range 0 to 2,500° F. are based on the calibration of 15 representative 8-gauge chromel-alumel thermocouples selected after preliminary tests on 50 heats of each alloy made by the method regularly used. The tables give the temperature-e.m.f. relation of the thermocouples now being manufactured as closely as the wires can be reproduced at the present time. The guarantee limits have been fixed by the manufacturer at ±5° F. in the range 0 to 660° F. and to ±¾ per cent. in the range 660 to 2,300° F. The methods used in calibrating the thermocouples in the various temperature ranges are briefly described. AUTHORS.

***2175. Methods of Testing Thermocouples and Thermocouple Materials. W. F. Roeser and H. T. Wensel.** *Bureau of Standards, J. of Research,* 14. *pp.* 247–282, *March,* 1935.—This paper describes various methods used for testing thermocouples and thermocouple-materials, and the precautions which must be observed in order to attain various degrees of accuracy. In particular, it describes in detail the methods developed and used at the National Bureau of Standards. It also provides some guidance to the reader in the selection of the method which is best adapted to a given set of conditions. AUTHORS.

2176. Approach to the Absolute Zero of Temperature. F. Simon. *Roy. Inst., Proc.* [29 *pp.*], *Advance copy received March* 22, 1935.—High-temperature states are considered as states of increased atomic disorder, low temperature states as states of increased atomic order. Hence the latter are more difficult of attainment than the former. Absolute zero of temperature corresponds to a state of perfect atomic order and is therefore unattainable. Lecture experiments relating to the liquefaction of helium, the attainment of a temperature of 0·1° Abs. by the adiabatic magnetisation and demagnetisation of paramagnetic salts, the measurement of extremely low temperatures using the magnetic susceptibility of a paramagnetic substance as a measure of temperature and the phenomena of supraconduction are described. J. S. G. T.

2177. Temperature of the Langmuir Hydrogen Flame. H. v. Wartenberg and H. J. Reusch. *Göttingen Nachrichten,* 1. 11. *Fachgruppe* 2. *pp.* 141–145, 1934.—A spectrophotometric method is used to determine the temperature existing in the electric arc between W electrodes immersed in a stream of H_2. A table is given showing the temperatures recorded for various arc conditions; the hottest flame is obtained with an electrode separation of 2 mm. with an arc current of 25 amperes at 130 V, the rate of flow of H_2 being 36 l. per sec. H. J. H. S.

See also Abstract 2184.

THERMOCHEMISTRY.

2178. Ignition of Explosive Gas Mixtures by High-Speed Electrons. A. E. Malinowski and K. A. Skrynnikow. *Phys. Zeits. d. Sowjetunion,* 7. 1. *pp.* 43–48, 1935. *In German.*—Experiments were made to ignite an explosive gas mixture by electron streams from Lenard tubes and Coolidge tubes. For electron current strengths in the explosion chamber up to $2 \cdot 24 \times 10^{-6}$ ampere the experiments gave negative results. Details of the apparatus are given and the results compared with the work of other observers. The experiments are to be continued with more powerful tubes. R. L.

2179. Correlation of Flame Movement and Ionisation Current During Explosions. W. A. Kirkby. *Chem. Soc., J. pp.* 160–165, *Feb.,* 1935.—Photographs are given of explosions of "moist" and "dried" mixtures of carbon monoxide and oxygen. For "moist" mixtures the flame vibrates with a frequency which increases as the explosion proceeds. The flame speed for "dried" mixtures is much slower than for "moist" mixtures. There is no vibratory movement of flame. There are also no small fluctuations of constant frequency in the ionisation current-time curves as in the "moist" mixtures. J. K.

2180. Correlation of Ionisation and Radiation in $CO - O_2$ Explosions. W. A. Kirkby. *Chem. Soc., J. pp.* 165–168, *Feb.,* 1935. —It is now shewn that the decay of ionisation is different in character from the decay of the afterglow. The former follows the law of recombination of ions, and so the decay of the afterglow cannot be wholly attributed to ionic recombination. Photoelectric cells have been used in the present work. J. K.

2181. Origin of Luminosity Accompanying Detonation of Explosives. H. Muraour and A. Michel-Lévy. *Comptes Rendus,* 200. *pp.* 924–926, *March* 11, 1935.—The shape of the luminous effect and the fact that the explosive wave itself is not luminous have been urged against the theory that the luminosity accompanying detonation is mainly due to intense heating of the surrounding gas by the explosive wave. It is, however, pointed out that the adiabatic compression due to the wave is sufficient to raise the temperature as required, and also to dissociate the molecules and ionise the atoms, causing intense ionisation and consequent luminosity. This is supported by the fact that luminosity increases in He, Ne, A and Kr in the order of decreasing dissociation potential. The possible bearing of atomic oxygen and ionised gases on the safety of explosives in coal mines is considered. [See Abstracts 3744 (1933) and 1728 (1935)]. C. A. S.

2182. Mechanism of Explosions and Combustions. Part II. W. Jost. *Zeits. f. Elektrochem.* 41. *pp.* 232–253, *April,* 1935.—The author continues his summary of the literature under the headings: Theory of explosion limits; induction periods in combustions; oxidation of phosphorus; combustion of H_2S and of CS_2; combustion of H_2 and of CO; combustion of hydrocarbons; "knocking" process. References to 190 papers are collected. [For Part I see Abstract 1727 (1935).] T. H. P,

2183. Transformation of o- into p-Hydrogen in the Solid Condition. E. Cremer. *Zeits. f. phys. Chem.* 28. *Abt. B.* 3. *pp.* 199–214 1935. Further experiments by the same or slightly modified methods [see Abstract 3692 (1933)] confirm the change in velocity constant, k, of the transition o- → p-hydrogen on solidification, from 12 to 19. The change occurs when there remains a residue of o-H_2 amounting to about 19 % of the total ($o + p$-H_2). This is too great to be explained by the isolation through progressive reaction theory, which at most could account for 16·7 %, there must also be mutually unfavourable placed pairs of o-H_2 molecules. An alternative explanation is formation in solid H_2 of a mixed phase. The two theories forecast variations with temperature in opposite directions. Spin diffusion ($o + p \rightarrow p + o$) is independent of temperature. The accelerating effect of solid air is traced to O only. The diffusion constant is 1–10 (probably about 3) cm.^{2}/day. C. A. S.

2184. Transformation Temperature of Grey Sn ⇌ White Sn. E. Cohen and A. K. W. A. van Lieshout. *Zeits. f. phys. Chem.* 173. *Abt. A.* 1. *pp.* 32–34, 1935.—A dilatometer method is employed to determine accurately the transformation temperature of the allotropic forms of Sn. It is given as $13 \cdot 2 \pm 0 \cdot 1°$ C. at atmospheric pressure. H. J. H. S.

2185. Recombination of Hydrogen Atoms. W. Steiner. *Faraday Soc., Trans.* 31. *pp.* 623–636, *April,* 1935.—Results for the rate of recombination of hydrogen atoms given in a previous paper [see Abstract 3708 (1931)] are corrected by means of a new precise calculation taking into account the effect of diffusion. It is found that in addition to the homogeneous three-body-collision reaction there is a small wall reaction. Therefore only an upper limit can be deduced for the recombination constant $k_m < 13 \cdot 0 \pm 2 \cdot 0 \times 10^{15}$ cm.^{6} sec.$^{-1}$ mole^{-2} at 20° C. for a molecule as third colliding particle. This value is 1/10 or less when an atom is the third colliding particle. According to a rough estimate the real value is nearly $k_m = 11 \cdot 0 \pm 2 \cdot 0 \times 10^{15}$ cm.^{6} sec.$^{-1}$ mole^{-2} at 20° C.

AUTHOR.

See also Abstracts **2177**, **2229**.

THERMODYNAMICS.

2186. Preliminary Selection of Arbitrary Functions in the Thermodynamical Equation of State. W. Jacyna. *Acad. Polonaise Sci. et Lettres, Bull.* 8–9*A*. *pp.* 375–378, *Oct.-Nov.,* 1934. *In English.*—If the specific heat at constant volume be $C_v = f(t)$ it is demonstrated under the selective conditions, $v > 0$; $\psi \gg 0$, $(\delta p/\delta v)_t \ll 0$ and $\psi = \psi\,(t)$, that the thermodynamical equation of state has the form $p = \psi\,\phi\,(v)$ and that the internal energy $U = F\,(t)$. The formulation of the following corollaries is then permitted: (1) If the internal energy of the real body depends not only on the temperature t, but also on the volume v, the specific heat of the body must depend not only on the temperature t but also on the volume v. (2) The internal energy of the real body in all the regions of state with $C_v = f(t)$, cannot be rationally determined with the half of the sum of separate functions of temperature and volume, *i.e.*, $\mathrm{U} \pm \Sigma_t \mathrm{F}(t) + \Sigma_t \phi_t(v)$ when $C_v = f(t)$. (3) The prevalent term of deviations of state of a real body from the equation $p = \psi\phi(v)$ is not $\zeta(v)$, but the function of both the variables, having the general form $\Omega(t_1 v) = \frac{1}{\mathrm{A}} \int d\psi \int \frac{1}{\psi} \left(\frac{\delta C_v}{\delta v}\right)_t d\psi$, where $1/A$ is the equivalent of heat.

H. H. Ho.

2187. Equation of State for Helium in the Intermediate Region of Temperature. W. Jacyna, S. Derewjankin, A. Obnorsky and T. Parfentjev. *Acad. Polonaise Sci. et Lettres, Bull.* 8–9*A*. *pp.* 379–386, *Oct.-Nov.*, 1934. *In English.*—The equation of state for He is shown to have the following form: $vp. = \mathrm{R}\psi + p \ \{a_0 + t\,(a + a_1 e^n)\}$, where the constants a_0 and a calculated from Holborn's, Otto's, etc. data in all the regions of state from −150° C. to 500° C. and from 0 to 100 atm. have the following values: $a_0 = 0{\cdot}002964$ (m^3/kg.), $a = -\,0{\cdot}000001085$ $\left(\frac{m^3}{°\mathrm{C.}}\Big/\mathrm{kg.}\right)$, so that $a_1 = \frac{a_0}{\psi_0} - a = 0{\cdot}00001193 \left(\frac{m^3}{°\mathrm{C.}}\Big/\mathrm{kg.}\right)$ with the value for the absolute ice-point $\psi_0 = 273{\cdot}22°$ K. and gas constant $\mathrm{R} = 211{\cdot}82$. The deviations from the above equation are discussed with graphical and tabular data. The average discrepancy between the experimental and calculated values is less than 0·003 %. H. H. Ho.

2188. Boyle Region in the New Theory of the Equation of State. W. Jacyna, S. Derewjankin, A. Obnorsky and T. Parfentjev. *Zeits. f. Physik*, 94. 3–4. *pp.* 224–228, *March* 19, 1935.—The second virial coefficient of the two classical forms of the equation of state are shown to be functions converging to zero value as at $p = o$, while the entire limiting dilution states are regarded as belonging to the Boyle-region instead of being defined by a definite Boyle-temperature at which $[(\delta(vp)/\delta p)_t]_{p=o} = o$. At the Jacyna basis-line, $\Delta_v = f(t, p) = 0$, which includes the Boyle-region, the volume deviation changes its sign. The included calculations show that the above deductions are valid from 500° to − 270·52° C. and from 0 to 15000 atmospheres. H. H. Ho.

2189. Boundary between the Homogeneous and Heterogeneous Regions as Deduced from van der Waals' Equation. D. P. Misra. *Tôhoku Math. J.* 40. *pp.* 57–58, *Jan.*, 1935. *In English.*—A supplementary note in connection with an earlier paper [see Abstract 4249 (1931)] which explains that the volume of gas can be varied so that b falls within the range of curves previously drawn, and discusses further points concerning the roots of van der Waals' cubic equation. W. R. P.

2190. Activity Coefficients of Gases. R. H. Newton. *Indust. and Engin. Chem.* 27. *pp.* 302–306, *March*, 1935.—In dealing with high-pressure equilibria, the ratio of the fugacity to the pressure of a gas (herein called the "activity coefficient") is an important function in that it furnishes a convenient means of calculating the fugacity. This ratio is shown to be a function of the reduced temperature and reduced pressure only, for a large number of substances, and curves of the activity coefficient *vs.*P_r at various values of T_r are given for the entire known range of T_r and P_r. AUTHOR.

2191. Thermodynamics of Solid Solutions. Part II. H. Seltz. *Am. Chem. Soc., J.* 57. *pp.* 391–395, *March,* 1935.—Employing a graphical method [see Abstract 2111 (1934)], the forms of phase diagrams for binary systems which show complete solid miscibility are considered in relation to the types of deviations from Raoult's law in the liquid and solid solutions. Positive deviations in the liquid phase with negative deviations in the solid phase give rise to diagrams showing a maximum. The types of diagrams resulting from negative deviations in both phases depend on the relative magnitude of these deviations. The various possibilities are considered. A phase diagram with liquidus curve displaced above the ideal and with the solidus displaced below is shown to require the existence of very unusual activity curves. AUTHOR.

2192. Thermodynamic Study of Systems of the Type $PbCl_2$—RCl—H_2O at 25° C. Part III. (Miss) D. M. Brasher and H. N. Parton. Part IV. H. N. Parton. *Faraday Soc., Trans.* 31. *pp.* 681–689, *April,* 1935.—In Part III. measurements have been made of the activity of $PbCl_2$ in presence of NaCl in aqueous solutions up to saturation with both salts. The effect of the addition of $PbCl_2$ on the activity of water in saturated NaCl solutions has been calculated. In Part IV. the activity of $PbCl_2$ in aqueous solution has been determined in presence of LiCl. The effects of the addition of KCl, NaCl and LiCl on the activity of $PbCl_2$ have been briefly compared. " Isodynes " or lines of constant activity of $PbCl_2$ have been constructed in both parts. [For Parts I. and II. see Allmand and Burrage, Abstracts 3232 (1927) and 3706 (1933).] AUTHORS.

See also Abstracts 1955, 2169, 2172.

VAPOUR PRESSURE.

2193. Vapour Pressure of Binary Solutions of Ethyl Alcohol and Cyclohexane at 25°. E. R. Washburn and B. H. Handorf. *Am. Chem. Soc., J.* 57. *pp.* 441–443, *March,* 1935.—A modification of the dynamic method for measuring vapour pressures devised by Pearce and Snow [see Abstract 1817 (1927)] has been adapted to the determination of the total vapour pressure, and the partial vapour pressures of the components of binary solutions of ethyl alcohol and cyclohexane, ranging in concentration from pure alcohol to pure cyclohexane, at 25°. The data have been used to calculate the activity coefficients, which indicate the deviations from Raoult's law. Deviations from ideal behaviour have been discussed and explained on the basis of the difference in polarity and internal pressure of the two components. AUTHORS.

2194. Tonometry of Saline Solutions. J. Perreu. *Comptes Rendus,* 200. *pp.* 1030–1032, *March* 18, 1935.—The method (figured) depends on determining the difference in the levels of Hg in the two arms of a U-tube, the surface in one being exposed to the vapour from the solution under examination, that in the other to the vapour of pure water, the whole system being evacuated. In this way the vapour pressures of solutions of sodium carbonate and sulphate of various concentrations have been determined, and the solubility equation verified. The limit heats of solution thence deduced at 20° are respectively − 16·80 and − 13·78, as compared with experimental values − 16·60 and − 13·96 cal.

C. A. S.

See also Abstract 1953.

ACOUSTICS.

2195. Demonstration of Beat Note and Other Phenomena. R. M. Sutton. *Science*, 81. *pp*. 255–256, *March* 8, 1935.—Two whistles are made from 6 cm. lengths of brass tube 4 mm. in internal diameter, threaded internally by a 10–32 tap. A V-shaped mouth is cut at the middle of the tube, and a piece of 10–32 screw, flattened on one side to make a narrow air passage, is fixed in the upper end to direct the air against the lip, and a movable 10–32 screw in the lower part controls the pitch. The whistles give a loud fundamental with an approximate range from 2500 to 5000. The whistles are connected to a T-piece, and may be adjusted to sound in unison, or to produce a beat note which rises in pitch as one of the whistles is lowered from unison. The effect of temperature is obtained by holding a lighted match under one whistle. By using coal gas to blow one whistle, the effect of gas density on pitch may be demonstrated, the two whistles being first tuned in air. The Doppler effect may also be shown. With smaller whistles at higher frequencies the beat note disappears when either whistle sounds beyond the upper limit of audibility. G. E. A.

2196. Rotational Dispersion of Sound in Hydrogen. A. S. Roy and M. E. Rose. *Roy. Soc., Proc.* 149*A*. *pp*. 511–522, *April* 10, 1935.—The dispersion of sound in hydrogen is investigated. The results show that no variation of velocity occurs below frequencies of the order 10^6 c.p.s. This is to be expected from the classical theory of Jeans as well as from the quantum treatment of the inelastic collision between two hydrogen molecules. AUTHORS.

2197. Action of Ultrasonic Waves on Photographic Plates. N. Marinesco and M. Reggiani. *Comptes Rendus*, 200. *pp*. 548–550, *Feb*. 11, 1935.—Contrary to what was previously stated [see Abstract 2510 (1933)] ultrasonic waves form a latent image on a photographic plate placed in pure water and exposed to them in darkness, or, if developer be substituted for the water, a visible image is obtained directly. This image consists of rhythmic fringes showing periodic distances depending on the wave-length, whence can be deduced the velocity of the waves, *e.g.*, 1800 m./sec. in a dilute (1 : 3) developer. C. A. S.

2198. Optical Measurements of Ultrasonic Velocities in Liquids. C. Bachem and E. Hiedemann. *Zeits. f. Physik*, 94. 1–2. *pp*. 68–71, *March* 12, 1935.—The velocities of ultra-sonic waves in toluol, benzol, CCl_4 and m-xylol are measured by a previously described method [see Abstract 4152 (1934)]. These are respectively 1303·3, 1299·6, 921·2 and 1321·9 m./sec. The relative accuracy being about 0·1 % and the absolute accuracy about 1 %. By taking suitable precautions both accuracies may yet be considerably improved. J. E. K.

2199. Acoustic Threshold Values. E. Waetzmann and L. Keibs. *Ann. d. Physik*, 22. 3. *pp*. 247–256, *March*, 1935.—Different methods of determining the damping of sound waves in tubes are discussed. Values of the damping constant β found by a method using a thermophone as source and employing a compensation microphone, show good agreement with the values calculated from Kirchhoff's formula. The values of β will be used when acoustic resistances, such as the membrane impedance, have been measured for the particular tube used. [See also Abstract 3363 (1934).] A. W.

2200. Audible Minimum and Contrast Threshold. J. L. van Soest and P. D. Groot. *Physica,* 2. *pp.* 196–200, *March,* 1935. *In German.*—In psychological measurements there must always be taken into account a disturbance level; otherwise false conclusions are frequently made. The Weber-Fechner law is discussed and adapted, and the audible minimum is expressed as a linear function of the contrast threshold. In a silent chamber, the pulse is found to affect the perception of sound. Using a statistical method the contrast threshold was determined by means of the period of the pulse. The value found, 0·08 – 0·10, agrees well with determinations made by quite different methods. G. E. A.

2201. Increase of Loudness with Number of Sound Sources. E. Lübcke. *Zeits. f. techn. Physik,* 16. 3. *pp.* 77–80, 1935.—If an observer listens to two loud-speakers of equal loudness, the sound paths to the observer's ears from the two loud-speakers being different, measurements here given show a subjective increase of loudness, as compared with that for a single loud-speaker, of 5 to 6 phons. Objectively an increase of only about 3 phons was observed and the same result was obtained subjectively when the sound path difference for the two loud-speakers was zero. An explanation of the difference between the subjective and objective results, based on the physical characteristics of the ear, is given. A. W.

***2202. Valve Voltmeter with Logarithmic Indication. E. Meyer and L. Keidel.** *E.N.T.* 12. *pp.* 37–46, *Feb.,* 1935.—For various branches of acoustics a meter is required the indications of which are proportional to the logarithm of the input voltage and which is set up in the shortest possible time. Such an apparatus is described. The principle on which it works is that the rectifier output voltage of an amplifier so regulates on a d.c. instrument the fluid resistance at the input terminals of the amplifier that the direct current rises proportionally with the logarithm of the voltage being metered. The properties of the arrangement are explained, the range amounting to 80 db, speed 600 db/sec. The application of the apparatus to reverberation-time measurements, comparison of microphone characteristics with standard, and visual use by means of a phosphorescent disc are described and illustrated. J. E. B.

See also Abstract **2313.**

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORK.

2203. Negative-Resistance Device and Its Application to Harmonic Analysis. C. W. Oatley. *Phys. Soc., Proc.* 47. *pp.* 471–476, *May* 1, 1935.—A description is given of a negative-resistance device which is very similar in principle to the kalliroton amplifier by L. B. Turner. It is shown that when this device is used to decrease the effective resistance of a tuned circuit no appreciable distortion of the resonance curve of the circuit is produced. A method is given whereby the effective resistance of the tuned circuit may quickly be adjusted to any predetermined value. AUTHOR.

CONDUCTION AND DISCHARGE IN GASES.

2204. Character of the Oscillating Spark Discharge. I. C. Purcaru. *Zeits. f. Physik,* 93. 5–6. *pp.* 315–319, *Jan.* 19, 1935.—The time course of the spark discharge between ellipsoidal electrodes in an oscillatory circuit was studied by photographing the spark on film carried by a rotating disc. Various types of discharge were observed and photographs together with some time measurements are included in the paper. W. S. S.

2205. Ion Distribution During the Initial Stages of Spark Discharge in Non-Uniform Fields. C. D. Bradley and L. B. Snoddy. *Phys. Rev.* 47. *pp.* 541–545, *April* 1, 1935.—A method is given whereby a direct study of ion distribution during the initial stages of spark discharges may be made by means of a Wilson cloud chamber and a potential impulse of less than 10^{-7} sec. duration. Photographs are shown for ion distribution between a point and plane with the point both negative and positive. The mechanisms responsible for the initiation in these cases has not been discovered. It was found that a maximum field of 10^5 to 10^6 V/cm. was a necessary condition for ionisation. With the point negative this could cause sufficient auto-electronic emission to start the discharge. With the point positive it is shown that it is improbable that free electrons in the gas are necessary for initiation of ionisation. AUTHORS.

2206. Variation of Mobility of Gaseous Ions with Temperature. Part I.—Positive Ions in Their Own Gas. A. M. Tyndall and A. F. Pearce. *Roy. Soc., Proc.* 149*A*. *pp.* 426–434, *April* 10, 1935.—A method has been developed for determining the effect of temperature on the mobility of positive ions in pure gases. It has been applied to the positive ion of He in He and to the N_2 molecular ion in N_2 over a temperature range from 20° K. to 480° K. in He, and from 65° K. to 590° K. in N_2. If the results are expressed at normal density instead of as commonly, normal pressure, the mobility in He is practically independent of temperature from 480° K. down to about room-temperature, below which there is a marked decrease. In N_2 the decrease in mobility with decrease in temperature is continuous over the whole range. Owing to lack of knowledge of the precise effect of electron exchange on the mobility of ions, it is not possible at present to use these results to deduce the forces between the ions and the gas atoms or molecules with which they are colliding. It is therefore proposed to extend the experiments to alkali ions in inert gases, since exchange processes do not then occur. AUTHORS.

2207. Theory of Kathode Sputtering. R. Seeliger and K. Sommermeyer. *Zeits. f. Physik*, 93. 9–10. *pp*. 692–695, *Feb*. 14, 1935. —Knudsen's cosine law is found to hold for the distribution of particles emitted when a metal surface is bombarded by canal rays. H. L. B.

2208. Electrophoresis in the Positive Column of a Gas Discharge. M. J. Druyvesteyn. *Physica*, 2. *pp*. 255–266, *March*, 1935. *In English*.—In the positive column in a noble gas the gas pressure near the anode, in the stationary state, is higher than near the kathode; this difference is calculated and the results are compared with experiments of Rüttenauer. In the positive column in a noble gas with a small admixture of metal vapour the concentration of metal vapour is highest near the kathode. The magnitude of this effect is calculated and the results applied to a Mg-vapour tube (Mg-cataphoresis tube), the spectrum of which is discussed. AUTHOR.

2209. Spectral and Impact Phenomena in the Faraday Dark Space. K. G. Emeléus and O. S. Duffendack. *Phys. Rev*. 47. *pp*. 460–466, *March* 15, 1935.—In pure He the negative glow emits He and He^+ lines and He_2 bands while the transition region between negative glow and Faraday dark space emits only He λ5016, $2^1S - 3^1P$, with observable intensity, and the He_2 bands, which are much stronger. When a trace of N_2 is added the transition region emits N lines instead of He_2 bands. Collisions between normal atoms and fast primary electrons are the important factor in the negative glow, and second-kind collisions between normal atoms and metastable 2^1S atoms in the Faraday space. Union of He atoms in 1^1S and $2^{1,3}S$ states in a three-body collision produces He_2 in $2^{1,3}\Sigma$ states, and the metastability of $2^3\Sigma$ accounts for the presence of visible He_2 bands. In pure helium the metastable molecules are further excited by slow-electron impacts, but if N_2 is present they are destroyed by second-kind collisions with N_2 molecules in which the latter are dissociated (presumably from a higher N_2 level to which they are raised in the collisions). These conclusions from observations in He and $He + N_2$ are supported by observations in $He + O_2$ and $He + CO$ and similar experiments with Ne and with A. W. J.

2210. Conductivity Produced in Ne and He by Irradiation with Their Own Resonance Radiations. R. W. Smith and O. S. Duffendack. *Phys. Rev*. 47. *pp*. 473–478, *March* 15, 1935.—The condictivity of He and Ne within a discharge tube, but at some distance beyond the end of the discharge was investigated at pressures from 0·25 mm. to 14 mm. It is shown that the metastable atoms, and the ions causing the conductivity are formed between the collecting electrodes. The results cannot be reconciled with the propagation of resonance radiation by diffusion, for they indicate an abnormally long free path for the resonance radiations of He and Ne. It is suggested that electron emission by impacts of metastable atoms is the chief factor in producing the conductivity. A and Kr in small quantities increase the conductivity of Ne and He, due to the action of the metastable atoms of the main gas in ionising the A or Kr. Ne greatly decreases the conductivity of He, while He has no measurable effect on Ne. J. E. R.

2211. Negative Ions of Iodine. Part I. Probe Measurements. J. L. Spencer-Smith. *Phis. Mag.* 19. *pp.* 806–823, *April,* 1935.—It is shown from general considerations that the glow-discharge in iodine at low pressures probably contains large numbers of negative ions. This is verified by Langmuir probe measurements, which show that the negative ion concentration is approximately equal to that of the positive ions and much greater than that of the free electrons, which may be of the order of 100 times smaller. A study of discharges in mixtures of helium and iodine demonstrates and to some extent elucidates the controlling effect exerted on the discharge by a strongly electronegative substance. Data are given in illustration of these statements. AUTHOR.

2212. Ionisation of Inert Gases by Positive Alkali Ions. R. N. Varney. *Phys. Rev.* 47. *pp.* 483–487, *March* 15, 1935.—The ionisation potentials of the noble gases under impact of various positive alkali ions have been determined in a new and independent manner which employs the neutralisation of an electron space-charge by the newly formed positive ions to show the ionisation. The method is extremely sensitive to the positive ions but is not affected by the secondary electrons which are liberated from the walls. The potentials found are different for each combination of gas and alkali ion and range in value from 5 to 20 times the electron ionisation potentials. They are lower, by amounts running as high as 45 volts in some cases, than those found by Beeck and Mouzon [see Abstract 1715 (1932)]. No ionisation was observed by Li^+ ions, none by Na^+ ions except in Ne gas, or in Ne gas by any ions but Na^+. When the actual energies available for ionisation, after conservation of energy and momentum have been taken into account, are calculated, the results are strikingly self-consistent, whereas the unreduced results are not at all so. Certain results published by Beeck and Mouzon, but which could not be checked by the author, fail to show this self-consistency. AUTHOR.

2213. Behaviour of Electrons in Chlorine. V. A. Bailey and R. H. Healey. *Phil. Mag.* 19. *pp.* 725–745, *April,* 1935.—The motions of electrons in Cl_2 is studied by means of observations on Cl_2 and on mixtures of Cl_2 with CO_2 or He. The theory of a new method used is given in detail, and its advantages are discussed. The values in Cl_2 of L the mean free path of an electron in the gas at 1 mm. pressure, λ the mean proportion of its own energy lost by an electron at a collision with a gas molecule, and h the probability of an electron becoming attached to the molecule with which it collides, deduced from the observations, are shown in terms of the velocity u by means of curves. The results obtained by means of three different methods are found to be in excellent agreement. The values of k the mean energy of agitation of an electron in terms of the mean energy of agitation of a molecule at 15° C., W the drift velocity of an electron in the direction of Z, and a/p the probability of attachment of an electron per unit length in the direction of the electric force at unit pressure, for electrons in Cl_2, are also deduced, and shown in terms of Z/p by means of curves. A notable number of free electrons is observed in pure Cl_2 at pressures from 0·1 to 3·3 mm. and forces from 5 to 10 V/cm. It is found that L, λ, and h vary considerably with the electronic velocity u. There is a general correspondence between the values of λ and the optical absorption spectrum. Also the variation of h is similar to that of L. The bearing of these results on certain published views about the motions of electrons in gases is also discussed. [See Abstract 2984 (1934).] AUTHORS.

2214. Probability of Collision for Slow H^+, $(H^1H^1)^+$, $(H^1H^2)^+$, $(H^2H^2)^+$, $(H^2)^+$ and He^+ Ions in Argon. E. B. Jordan. *Phys. Rev.* 47. *pp.* 467–472, *March* 15, 1935.—The probability of collision P_c for slow H^+, $(H^1H^1)^+$, $(H^1H^2)^+$, $(H^2H^2)^+$, $(H^2)^+$ and He^+ ions in argon has been measured. The energy range studied was 225 to 4200 V for the H^+ and $(H^1H^1)^+$ ions, 225 to 1300 V for the $(H^1H^2)^+$, $(H^2H^2)^+$ and He^+ ions and 300 to 1225 V for the deuton hydrogen molecular ion $(H^1H^1)^+$ beam. The probability of collision for the $(H^1H^1)^+$ ion decreased from a value of $P_c = 56$ at 225 V to a minimum value of 48 at 784 V with a subsequent increase to $P_c = 57$ at 3840 V. The proton curve increases from $P_c = 38$ at 225 V to $P_c = 46$ at 4220 V. It gradually flattens out at the higher voltages. The $(H^1H^2)^+$ and $(H^2H^2)^+$ curves remain nearly constant at $P_c \cong 41$ and 39, respectively, while the He^+ curve decreases from $P_c = 28$ at 225 V to 24 at 1225 V. The curve obtained by using a deuton hydrogen molecular ion beam shows two distinct minima at 380 and 806 V. The percentage of $(H^1H^1)^+$ ions in the beam was estimated to be 15 %. The $(H^1H^1)^+$ and H^+ curves, and the $(H^1H^1)^+$, $(H^1H^2)^+$, $(H^2H^2)^+$ and He^+ curves are grouped separately for comparison, and the probable processes in each case are discussed. It is significant to note that the heavier isotopic molecular ions have a longer mean free path in argon than the lighter $(H^1H^1)^+$ ion. A possible source of the discrepancies between the results of different authors in this field is discussed. AUTHOR.

2215. Cleaning of Surfaces. J. Strong. *Rev. Sci. Instruments,* 6. *pp.* 97–98, *April,* 1935.—Experiments established the identical nature of the surface changes in gold when bombarded by electrons [see Abstract 1652 (1931)] and those produced on glass by the passage of the tip of a small blowpipe flame [see Abstract 266 (1923)], and are regarded as demonstrating the removal of some substance, probably a fatty acid, from the surface by ionic bombardment. Similar effects were obtained by means of the focussed radiations of a capillary quartz-mercury arc, and were probably due to photoelectrons. P. H. B.

2216. Positive Ion Currents Produced in a High Vacuum. R. Planiol. *Comptes Rendus,* 200. *pp.* 730–731, *Feb.* 25, 1935.—Making use of the atomic jet method previously described [see Abstract 1776 (1935)] experiments with mercury showed that parasitic currents of about 25 μA were considerably larger than the positive ion current, which was only about 1 μA. With Cd, however, and improved methods, the parasitic currents were only about 12 μA, with fluctuations of the order of $\pm 0 \cdot 1$ μA. Under these conditions it was found easy to observe the positive ion currents, which ranged from 10 to 30 μA. These currents were measured by the difference between the current values when the atomic jet was started and stopped. The marked increase of the ionisation current on heating the Cd was proved to be due to the atomic jet issuing from the metal and not to increase of the parasitic currents. A. W.

2217. Circuit for the Analysis of Geiger-Counter Pulses. W. E. Ramsey and M. R. Lipman. *Rev. Sci. Instruments,* 6. *pp.* 121–125, *April,* 1935.—A circuit is devised for analysing the size, the time of recovery and the form of the recovery curve of Geiger-counter pulses. The arrangement is such that the current through a galvanometer is zero when the input grid potential to the first valve is greater than a certain value V_0' and constant for potentials less than this value. By suitable amplification a ballistic throw is finally obtained which is proportional to the time the potential of the counter wire is more negative than any arbitrarily assigned. When the pulses are uniform their size is obtained in a few seconds; when they are non-uniform an average recovery time is all that can be determined. Apart from the magnitude of the current, the essential characteristic of the entire circuit depends on the first two valves. When the resistance to earth is high, the capacities to earth must be kept as small as possible if the circuit is to respond to pulses with a period $< 10^{-4}$ sec. The resistance in the screen grid circuit of the second valve must be kept as low as possible; otherwise the transmission of potential changes greater than V_0' in the plate circuit of the first valve destroys the sharpness of the cut-off. Results are given for counters 15 cm. and 3 cm. long and 1 cm. in dia.; in both cases the recovery is purely exponential and the discharge phenomena cease immediately after the initial breakdown of the counter. If the potential across the counter is considerably increased a change in the type of pulse is observed, the discharge maintaining itself for a relatively long time after which the potential recovers exponentially. F. C. C.

See also Abstracts 2039, 2045, 2046, 2047, 2074, 2075, 2144, 2177, 2178, 2304.

CONDUCTION IN SOLIDS AND LIQUIDS.

2218. Mean Free Path of Electrons in Silver. A. Eucken and F. Förster. *Göttingen Nachrichten,* 1. 10. *Fachgruppe* 2. *pp.* 129–137, 1934.—The mean free path of electrons in silver is deduced from measurements of the specific resistance of very thin wires of this element. Wires of the order of 1 μ diameter are used, which are prepared by drawing out a glass capillary containing the molten metal. It is found necessary to anneal the wires at a temperature of about 500° C. before consistent results can be obtained. The value finally given for the mean free path at 0° C. is $57 \cdot 7 \pm 0 \cdot 88 \times 10^{-7}$ cm. which agrees well with the value predicted by the Fermi-Sommerfeld theory. Earlier work on Bi [see Abstract 4297 (1934)] had given, on the other hand, a result in closer agreement with the classical theory. Other metals are to be examined. R. W. P.

2219. Thomas-Fermi Method for Metals. J. C. Slater and H. M. Krutter. *Phys. Rev.* 47. *pp.* 559–568, *April* 1, 1935.—The Thomas-Fermi method is applied to metals, by replacing each atom by a sphere, assuming the potential to be spherically symmetrical within it, and solving the Thomas-Fermi equation subject to the boundary condition that the electronic charge within the sphere shall balance the nuclear charge, rendering it electrically neutral. Calculations are presented giving potential field, charge density, and kinetic, potential, and total energy of the metal, as function of lattice spacing. The virial theorem is verified for the energy. The total energy shows no minimum, the pressure being always positive. Calculations are also made using the Dirac method of correcting for exchange, for three atoms, Li, M and Cu. The exchange lowers the energy, but still not quite enough to produce a minimum of energy and an equilibrium at zero pressure. The result should be useful as a first approximation in self-consistent field approximations for the structure of metals, and could be adapted to give approximate treatment for matter under very high pressure, as in stars. [See Abstract 5192 (1934).] AUTHORS.

***2220. D.C. Amplifier Circuits for Use with the Electrometer Valve. D. B. Penick.** *Rev. Sci. Instruments,* 6. *pp.* 115–120, *April,* 1935.—A number of balanced, single-valve, d.c. amplifier circuits are compared, which are applicable to the 4-element, low grid-current valve. The balance equations are stated for the most generally useful circuit, and magnitudes of the valve characteristics involved are given for the Western Electric No. D-96475 valve. Experimentally determined values of circuit constants observed under balance conditions are also given. The stability of the circuit is discussed, and a convenient procedure for obtaining a balance by experimental methods is suggested. AUTHOR.

***2221. Portable Reflecting Galvanometer. L. O'Bryan.** *Gen. El. Rev.* 38. *pp.* 103–104, *Feb.*, 1935.—A description of a portable moving-coil galvanometer in which portability is secured by the use of a double taut suspension ; sensitivity, which is reduced considerably by the necessary mechanical strength of the suspension, is improved by the use of newer magnetic materials in place of chrome steel. The moving system is complete in one unit and is easily removable from the fixed housing and permanent magnet. The whole is contained in a cast aluminium case with a lamp and scale. Examples are given of apparatus using these galvanometers self-contained ; they are a portable double bridge and a portable thermocouple potentiometer. Sensitivity figures are 0·014 μA for 1 division of 2 mm. for a resistance of 800 ohms. E. H. W. B.

***2222. Use of Thermionic Valves in the Measurement of Very Small Currents. J. Thovert.** *J. de Physique et le Radium,* 6. *pp.* 89–93, *March,* 1935.—By connecting the grid of a triode to the source of current and using the valve as an electrometer, currents of the order of 10^{-14} ampere may be measured. For the best results special valves must be used but ordinary " radio " valves are effective if the subsequent amplification circuit is carefully chosen. Attention is confined to the l.f. power valve and the screen grid valve and a table is given containing suitable values for the various components of the circuit. F. C. C.

***2223. Amplification of a Galvanometer Deflection by Retroaction with a Photo-Cell. W. L. Watton.** *Journ. Sci. Instruments,* 12. *pp.* 115–118, *April,* 1935.—A method of increasing the sensitivity of a mirror galvanometer is described, in which the light beam falls on to a photo-cell unit, the current from which is passed through the galvanometer to give an increased deflection, or otherwise to modify the effective galvanometer constants. An experimental assembly is described in detail and curves are given showing its performance. A mathematical treatment is given in an Appendix. AUTHOR.

2224. Mechanism of Action of Solid Electron Rectifiers. W. P. Jousé. *Phys. Zeits. d. Sowjetunion,* 7. 1. *pp.* 1–18, 1935. *In German.* —A new kind of solid electron rectifier was formed from Cu_2O with artificial blocking layer, which consisted of a badly conducting substance —SiO_2, B_2O_3, NaCl, S, glass, bakelite. The rectification coefficient attains 100 at 1 volt. The volt-ampere characteristics of such rectifiers, in which the thickness of the blocking layer was 1×10^{-6} to 5×10^{-4} cm., were measured up to 20 volts. In these experiments with the help of a telephone relay the tension could be inserted within a short time interval of $0{\cdot}8 \times 10^{-4}$ sec. It appears that in the case of a wedge-shaped blocking layer the maximum of the rectification coefficient occurs at a thickness of 2×10^{-6} to 1×10^{-5} cm., but rectification is still given at a thickness of 1×10^{-4} cm. A blocking layer photo-effect can be obtained if upon an electron half-conductor an artificial blocking layer with great internal photo-effect is imposed. J. J. S.

2225. Magnetic Effects in Supraconductors. F. G. A. Tarr and J. O. Wilhelm. *Canad. J. of Research*, 12. *pp.* 265–271, *Feb.*, 1935.—This paper deals with magnetic effects in metals cooled from above the transition temperature to below the supraconducting temperature, while in an applied magnetic field. Previous work of Meissner and Ochsenfeld indicates that at the supraconducting temperature, the effective permeability of the metal became zero. It is found, however, that the effective permeability is greatly influenced by the composition and geometrical shape of the specimen. There is also, in general, a reduction in flux on removing the magnetic field after the supraconducting temperature has been reached, but on re-establishing the field the flux through the specimen remains unchanged. AUTHORS.

2226. Electrical Conductivity and Galvanomagnetic Effect in a Metallic Compound of Li and NH_3. H. Jaffe. *Zeits. f. Physik*, 93. 11-12. *pp.* 741–761, *Feb.* 26, 1935.—It is found that a saturated solution of Li in ammonia in the proportions of 1 to 4 gives rise to a solid compound at $-180°$ C. The specific resistance of the saturated solution is about half that of mercury at room-temperature and is nearly independent of temperature, whilst that of the solid is much smaller and has a positive temperature coefficient of about 2 %. The saturated solution has a density of 0·48 at room-temperature and is the lightest liquid known. The solid shows a normal negative Hall effect, the constant being $-1\cdot38.\ 10^{-3}$ cm./ampere sec., from which it may be deduced that there is exactly one free electron present per atom of Li. At $-200°$ C. the solid transforms and the Hall constant increases fourfold and simultaneously the resistance shows a marked dependence on the magnetic field. H. J. H. S.

2227. Electric Conductivity of Pressed Powdered Graphite. Z. Specht. *Zeits. f. Elektrochem.* 41. *pp.* 204–207, *April*, 1935.—The author finds insufficient exactitude in his measurements of the specific resistance of powdered graphite under pressure to allow him to accept the formula for the dependence of the resistance σ on the pressure p as $\sigma = (a'/\sqrt{p}) + b'$, adopted by Brunner and Hammerschmid [see Abstract 1285 (1934)], in preference to $\sigma = (a/p) + b$. He maintains that the results from both are well within his experimental error. In reply **J. Brunner** and **H. Hammerschmid** point out that their greatest error is $\pm 0\cdot3$ % which is very much lower than that of the author. A table is given to show that the contact resistance between the graphite and the metal electrodes also alters with pressure, but in the reply it is pointed out that above a pressure of 76 atmospheres the change is negligible and so should not affect results. H. M. B.

2228. Electrical and Optical Properties of Semi-Conductors. Electrical Measurements on ZnO. O. Fritsch. *Ann. d. Physik*, 22. 4. *pp.* 375–401, *March*, 1935.—The electrical conductivity of single crystals, coarsely crystalline plates and vapour-deposited layers of ZnO is measured over the range of temperature from normal to that of liquid air. The slope of the curve showing the relation between log σ and $1/T$ (linear relation) is greater, the smaller the specific conductivity at room-temperature. O_2 has the effect of considerably lowering the conductivity under rapid cooling conditions but, by soaking in air or *in vacuo*, the conductivity is increased. The Hall effect sign is negative. The electron mobility is only slightly dependent on temperature. A small positive thermoelectric effect is observed in the range 80 to $-35°$ C. H. J. H. S.

2229. Velocity of Formation and Electrical Conductivity of β-Silver Sulphide. H. Reinhold and H. Möhring. *Zeits. f. phys. Chem.* 28. *Abt. B.* 3. *pp.* 178–188, 1935.—In order to test Wagner's theory of the reaction process (*Anlaufvorgang*), the velocity of formation and conductivity of $\beta-Ag_2S$ have been measured. By means of an automatic registering arrangement the time was determined in which a silver wire of definite thickness was converted into $\beta-Ag_2S$ in molten sulphur ; between 130° and 170° C. the reaction constant (*Anlaufvorgang*) is given by $k = 17e^{-10500/T}$. The specific conductivity of $\beta-Ag_2S$ depends greatly on the content of excess sulphur ; for Ag_2S in contact with molten S between 130° and 170° it is given by $X^S = 8 \times 10^8 e^{-10700/T}$ and for pure $\beta-Ag_2S$ between 20° and 180° by $X^N = 6 \times 10^6 e^{-6800/T}$ Comparison of the experimental values for the conductivity with those calculated from the diffusion constants shows that sulphur-free $\beta-Ag_2S$ is a mixed conductor with more than 99 % electron-conduction. T. H.P.

See also Abstracts 1928, 1930, 1998, 2170, 2202, 2277, 2298, 2318.

DIELECTRICS AND CAPACITANCE.

2230. Dipole Rotation in Solid Non-Crystalline Materials. A. Gemant. *Phil. Mag.* 19. *pp.* 746–758, *April*, 1935.—It is important to know whether the Debye theory of dipole rotation, originally developed for gases and liquids, can be used for solid materials of the amorphous, non-purely crystalline type (paraffin, glass, etc.). Such materials are here considered as possessing both a finite value of viscosity and a certain elasticity capable of relaxation. The original theory is extended under this assumption. It turns out that the equations relating dielectric constant and loss angle with frequency, temperature and the characteristic dipole data are but slightly affected by a finite elasticity. The position of the anomalous dispersion region as well as the height of the absorption are unaltered. The application of the dipole theory to such solids is therefore justified. AUTHOR.

2231. Dielectric Saturation and Hindrance of Free Rotation in Liquids. P. Debye. *Phys. Zeits.* 36. *pp.* 193–194, *March* 15, 1935. —The theory of a quasi-crystalline structure in liquids [see Abstract 1813 (1935)] is applied to the phenomenon of dielectric saturation as observed in associated liquids. An expression for the ratio $\overline{m}/\mu$, where $\overline{m}$ is the mean moment, produced by the orientation in the internal field, which is large enough to lead to saturation, and μ is the permanent moment, is derived. It involves a reduction factor (as compared with the case of free rotation) which can be calculated. In the case of water, the value $y = E/kT$ (E = potential energy of rotational displacement, k = Boltzmann constant, T = absolute temperature) deduced from the dielectric behaviour at small field strengths is 10, and this is exactly the value predicted from the new reduction factor, the validity of the initial assumptions thus being confirmed. C. B. A.

2232. Effect of Solvent in Dipole Moment Measurements. Polarisation and Moment of Nitrobenzene. M. A. G. Rau and B. N. Narayanaswamy. *Indian Accad. Sci., Proc.* 1*A. pp.* 489–497, *Feb.*, 1935.—The polarisations and moments of nitrobenzene in six solvents, hexane, heptane, cyclohexane, carbon tetrachloride, benzene and dioxane, have been determined over the temperature range 10° to 40° C. The polarisation values in each solvent, when plotted against

$1/T$, fall on a line which is concave to the $1/T$ axis. The bond moment for $N \rightarrow O$ calculated from the observed moment of nitrobenzene is only 1·61, as against the expected value of 7·23. If on the other hand 7·23 is assumed to be the order of the moment for $N \rightarrow O$, the structure of the $-NO_2$ group must be one which is in a state of quantum resonance between two equivalent structures. [See Abstract 5205 (1934) and following Abstract.] AUTHORS.

2233. Solvent Effect in Dipole Moment Measurements. M. A. G. Rau. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 498–509, *Feb.*, 1935.—The ideas leading up to Raman and Krishnan's theory of anisotropic field constants prevailing in a liquid medium are briefly recounted. On the basis of this theory a rigorous expression is derived for the polarisation of a solute in infinite dilution in a non-polar solvent, after eliminating the influence of the solvent. This equation is successfully applied to the data on the polarisation of nitrobenzene in different solvents [see preceding Abstract]. It is shown that the several empirical equations proposed to represent the solvent influence on the polarisation of the solute, all closely resemble the rigorous expression derived from the theory of Raman and Krishnan. AUTHOR.

2234. Electric Moments of Monohydric Normal Secondary and Iso-Alcohols. P. C. Mahanti. *Zeits. f. Physik*, 94. 3–4. *pp.* 220–223, *March* 19, 1935.—Measurements are recorded of the dipole moments of certain monohydric normal secondary, and tertiary alcohols of the fatty series, and their magnitudes found to be of the same order as for the normal primary alcohols. It follows, therefore, that the dipole moment is independent both of the position of the hydroxyl group and of the ramifications of the carbon chain in the molecule. H. H. Ho.

2235. Constitution of Double Layer and Shape of Potential Curve in Electrolytic Neutralisation of Metallic Ions. N. Thon. *Comptes Rendus*, 200. *pp.* 907–909, *March* 11, 1935.—From previous results the relation $i = A\epsilon + B\epsilon e^{k\epsilon}$ (ϵ stationary p.d., A, B, and k constants) for the permanent régime is deduced. At low intensities of current ohmic conductivity predominates. Neutralisation of ions accumulated by capacity becomes more important as the polarisation of the electrodes is greater. If however it is assumed that the desorption of ions retained by capacity opposes depolarisation and its probability increases with the density of charge of the electrodes, *i.e.*, according to the Coulomb law, then $i = A\epsilon + B\epsilon e^{k\epsilon} - B^1\epsilon^2$. [See Abstract 3013 (1934).] C. A. S.

2236. Self-Capacitance of Single-Layer Coils. W. Jackson. *Phil. Mag.* 19. *pp.* 823–835, *April*, 1935.—The self-capacitance of a series of air-dielectric single-layer solenoids of 2, 3, and 4, in. dia. and of length to diameter ratio extending from 0·25 to 4·1, has been determined from measurements of the natural frequency and by immersion in a liquid of known dielectric constant. It is shown that the self-capacitance is independent of frequency, and that the self-capacitance to radius ratio is independent of the radius for a given coil-shape. The results are compared with existing theories. A study has also been made of the effect of end-connections, wire diameter, wire covering, and of the presence of a coil former on the effective self-capacitance. Finally, mention is made of a few measurements on 2- and 3-layer coils. AUTHOR.

See also Abstracts 1921, 2284.

ELECTROCHEMISTRY.

2237. Transport of Electricity through Phase Boundaries. System I. Glass-Gas (or Vapour). C. Stüber. *Zeits. f. phys. Chem.* 172. *Abt.A.* 6. *pp.* 401–428, 1935.—From an anode in a vapour space a direct glow current flows through a glass diaphragm to the kathode. In this way the positive electricity-carriers produced in the glow space can be introduced into glass and there replace the alkali ions of the unipolar conducting glass. Experiments were made with He, O_2, CO_2, H_2, N_2, HCl, NH_3, C_6H_6, CCl_4, Na, K, Cd and Hg. In all cases the kathodic migration of the Na or K from the glass agrees with Faraday's law within the limits of experimental error. Of the gases and vapours tested, Na^+, K^+, H^+ and N (with valency unknown) pass into the glass. The behaviour of Hg and Cd vapours is still uncertain. Li vapour destroys the glass; He, O_2, CO_2 and CCl_4 show no electrolytic migration into glass and HCl, NH_3 and C_6H_6 are decomposed by the glow discharge. With all electrolyses of glass not connected with migration of kations, $SiO_3(SiO_2)_x$ radicals form at the anode side of the glass and decompose at higher temperatures into $SiO_2(SiO_2)_x + \frac{1}{2}O_2$; the increase in pressure observed with He, O_2 and CO_2 is ascribed to this process. With the help of Na- and K-vapour electrolysis Na and K mirrors were obtained in photo-cells fused directly on to the kathode space of the electrolysis vessel. The sensitiveness of these cells is of the order of magnitude recorded in the literature.

T. H. P.

2238. Influence of the Composition of Glass on the Boundary Phase Potential: Glass-Aqueous Solutions of Electrolytes. K. Evstropjev and N. Sujkovskaja. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 421–427, *Dec.* 21, 1934. *In German.*—It is shown that the influence of "foreign" kations (*e.g.*, Na, Li, Ba) increases in the region of small H-ion concentration, *i.e.*, in neutral and alkaline regions. It is also concluded that the potential of a glass electrode varies with the concentration of these different kations and further that these kations can be arranged in serial order. It would appear that the adsorbed ions in the absorbing layer exert a force which can be considered as a peculiar electrolytic "solution tension." J. K.

2239. Transfer of Electrons from Sodium into Rock-Salt. V. Južakov. *Comptes Rendus de l'Acad des Sciences, U.S.S.R.* 4. *pp.* 428–433, *Dec.* 21, 1934. *In German.*—When sodium is heated in rock-salt under certain conditions a violet coloration is produced; on cooling quickly the colour changes to yellow, typical of sodium in atomic division. This paper refers to a quantitative investigation of this phenomenon, applying for this purpose an electric current at different potentials. J. K.

2240. Passage of Current at Voltages Lower than the Decomposition Voltages of Electrolytes. I. Zlotowski. *Comptes Rendus,* 200. *pp.* 733–735, *Feb.* 25, 1935.—Examination of several dozen curves, obtained by means of the polarograph of Heyrovsky and Shikata, of the kathodic polarisation of solid-metal electrodes renewed in a continuous manner with velocity v, shows that the current can be expressed by the relation $I_r = A\{1 - 1/(B + Cv)\}$, where A, B and C are constants. According to this formula, as v increases, I_r tends towards a limit A, which is in practice reached for values of v of the order of 10^{-2} cm.^{2}/sec. This is not in agreement with the idea that the so-called "residual current" corresponds to the electrostatic charging of the condenser formed by the electrode and the layer of liquid close to it, but is what would be expected if the residual current is considered as an ordinary Faraday current.

A. W.

2241. Preparation of Thin Layers of Urano-Uranic Oxide by Electrolysis. M. Francis and Tcheng-Da-Tchang. *Comptes Rendus,* 200. *pp.* 1024–1027, *March* 18, 1935.—The oxide is deposited on a horizontal platinum kathode with the anode in the form of a stirrer, from a solution containing 10 mg. U_3O_8 (as nitrate), 2·25 cc. *N*-acetic acid, and 2 cc. *N*-ammonia, made up to 15 cc. with ethyl alcohol, at 60°. The deposit is washed with alcohol and heated in an electric furnace. Adherence is good if the thickness of the deposit is $< 0{\cdot}2$ mg./cm.^{2} The arrangement is figured. C. A. S.

2242. Preparation of Deuterium-Free Water : Deuterium Content of Ordinary Water : Atomic Weight of Hydrogen : Electrolytic Separation of Oxygen Isotopes. H. L. Johnston. *Am. Chem. Soc., J.* 57. *pp.* 484–486, *March,* 1935.—By the fractional electrolysis of 50 l. of ordinary water in five stages 45 cc. of deuterium-free water was obtained, whence by density determinations the ratio H/D was deduced as 5750 ± 250, and the atomic weight of normal H ($O^{16} = 16$) as 1·00795 or 1·00770 or 1·00775 on the chemical scale according to the O^{18}/O^{16} ratio used. The electrolytic separation factor of 10^{18} relative to O^{16} is 1·008 ± 0·003, which implies that if the whole ocean could be reduced by electrolysis to a residual 1 mm.^{3} that residue would only have barely double concentration of O^{18}. C. A. S.

2243. Kathodic Passivity. K. M. Gorbunova and A. T. Vagramian. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 443–453, *Dec.*, 1934. *In German.*—The kathodic passivity observed during the electrolytic formation of crystals has been investigated. Using Ag anodes and kathodes and $AgNO_3$ as electrolyte, marked differences in behaviour are found according as the kathode surface, after wet-polishing, is or is not allowed to dry in the air prior to immersion in the electrolyte. At the surface not subjected to contact with the air, nucleus-formation occurs at relatively low voltages, a large number of active centres being indicated. With the air-dried kathode surface, the voltage necessary for nucleus-formation is considerably higher, and the number of crystals formed falls, a single crystal only being frequently produced. These phenomena are explained by the formation of a gas-absorption layer on the kathode surface dried in the air, with the result that the active centres become occupied. The kathode surface undergoes passivification also within the electrolyte in cases where the electrolysis starts some time after the initial immersion in the electrolyte, or where the separation of the metal on the kathode is artifically delayed or interrupted. T. H. P.

2244. Anodic Passivation. W. J. Shutt. *Faraday Soc., Trans.* 31. *pp.* 636–637, *April,* 1935.—The paper forms an explanation of the reasons which induced Shutt and Walton to abandon the idea of the existence of any appreciable diffusion layer in their experiments on the anodic solution of gold. The solution of the gold was carried out in unstirred solutions of chlorides. In solutions which were vigorously stirred the diffusion layer was assumed to be reduced to molecular dimensions. F. J. B.

2245. Potential Oscillation of Iron in Nitric Acid. Part I. M. Karschulin. *Zeits. f. Elektrochem.* 41. *pp.* 224–229, *April,* 1935.—The periodic solution of iron in nitric acid was investigated by means of potential-time measurements. The iron was partially immersed in nitric acid and became covered by a dark reddish-brown layer, which at regular intervals of time gave rise to explosion-like evolution of gas which destroyed the layer. During the short period of gas formation the iron showed a positive potential. When the iron became covered by the reddish-brown layer, it showed a negative potential, which in turn gave place to the positive potential at the moment of the evolution of the gas. The periodic solution of iron, wholly immersed in 41·7 % nitric acid, was found to take place by the formation of gas on sharply defined surface particles alternately, and the phenomenon was photographed in a kinematograph. An attempt to explain these changes was made on the basis of the reduction of nitric acid by metals as recorded in previous work on that subject. F. J. B.

2246. Electrical Polarisation of Hydrogen Adsorbed on Pure Metal Surfaces. R. Suhrmann and H. Csesch. *Zeits. f. phys. Chem.* 28. *Abt.* B. 3. *pp.* 215–235, 1935.—Metallic surfaces, prepared by the vaporisation of Ag, Al and Tl in high vacua, and also of Pt surfaces, were examined by means of optical-electrical methods. The sensitivity curves of the surfaces were determined before and after the action of atomic H. The relative catalytic activity of the surfaces on the recombination of the H atoms was determined. An attempt is made to put forward a representation of the mechanism of the combination of H on metals. F. J. B.

2247. Salt Error and Normal Electrode Potential of the Quinhydrone Electrode. F. Hovorka and W. C. Dearing. *Am. Chem. Soc., J.* 57. *pp.* 446–453, *March,* 1935.—An improved method for the study of the quinhydrone-hydrogen cell has been developed. The salt error of the quinhydrone electrode has been determined with an accuracy of ±0·00003 V. for 14 solutes in concentrations from 0·05 to 2 *N*. All measurements were made at 25°. It was shown that there exists a near linear relationship between salt error and concentration of solute. Constants to be used in the correction of *p*H values were derived. Salt errors were found to be additive for many mixtures. Certain anomalies are exhibited by mixtures of sulphates and hydrochloric acid. The relation of salt error to the ratio γ_h/γ_q was discussed. The normal electrode potential, E_0, of the quinhydrone electrode, or more strictly of the system quinone-hydroquinone, was determined to be 0·69938 ±0·00003 V at 25°. The standard quinhydrone electrode was studied and found to have a potential, with respect to the hydrogen electrode, of 0·69915±0.00003 V at 25°. AUTHORS.

2248. Hydrogen Electrodes. M. Volmer and H. Wick. *Zeits. f. phys. Chem.* 172. *Abt. A.* 6. *pp.* 429–447, 1935.—Measurements of the course of the separation and resolution of hydrogen on electrodes of platinum, iridium and gold, were carried out in carefully purified electrolytes. The current-voltage curves were found to be linear in the neighbourhood of the equilibrium potential, a result in harmony with the discharge theory of overvoltage. The further course of the anode curves showed a deviation from the simple logarithmic curve. These results are discussed in relation to the change of activity of the electrodes. The effects of poison, *e.g.*, arsenious oxide, on the properties of the surface of the electrodes were investigated. F. J. B.

2249. Overvoltage of the Halogens. F. T. Chang and H. Wick. *Zeits. f. phys. Chem.* 172. *Abt. A.*6. *pp.* 448–458, 1935.—The discharge theory of overvoltage of Erdey-Grúz and Volmer is considered to be applicable to other cases than hydrogen. Experiments were made to explain the overvoltage of the halogens, under such conditions that the nature of the electrode process could be definitely shown. The current-voltage curves at the equilibrium potential yielded overvoltages for the separation of chlorine on platinum and iridium electrodes, and for bromine on iridium electrodes. The deposition curves were in harmony with the discharge theory. The re-solution curves showed similar deviations to those found for hydrogen. F. J. B.

2250. Delayed Discharge of Ions as Cause of Overvoltage. A. Smits. *Zeits. f. phys. Chem.* 172. *Abt. A.* 6. *pp.* 470–472, 1935.—The theory of electromotive equilibrium, proposed by the author some ten years ago, led to the conclusion that the overvoltage of hydrogen was due to the slow discharge of the hydrogen ions, and that kathodic polarisation in general was brought about by the delaying of the discharge of ions. The author proceeds to show that Volmer and Erdey-Grúz, in ignorance of his theory, had arrived at similar conclusions. F. J. B.

2251. Overvoltage at Bright Platinum Electrodes in Sulphuric Acid. A. L. Ferguson and G. M. Chen. *J. Phys. Chem.* 39. *pp.* 191–198, *Feb.*, 1935.—A study is made of overvoltage phenomena at both anodes and kathodes of bright platinum in $2\,N$ H_2SO_4. An oscillograph was used to obtain charge and discharge curves. Curves are obtained which show the influence of time and current density. A comparison is made of the direct method, the commutator method, and the electromagnetic interrupter. An attempt is made to distinguish between discharge curves due to a pure resistance, those due to true depolarisation, and those due to a combination of the two [see Abstract 868 (1935)]. AUTHORS.

***2252. Plant for the Production of Heavy Water. W. G. Brown and A. F. Daggett.** *J. Chem. Phys.* 3. *pp.* 216–218, *April*, 1935.—A description is given of a plant for the production of deuterium oxide by the electrolytic method which operates with a higher efficiency than has been previously reported for this method. The fractionation factor, uncorrected for evaporation, averages 8·6. Steel cells, which also serve as the kathodes, are used and the entire construction is explosion-proof. AUTHORS.

See also Abstracts 1914, 1949, 1997, 2235.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

2253. Density of Electric Charge and Electron Radius. E. Reichenbächer. *Phys. Zeits.* 36. *pp.* 173–177, *March* 1, 1935.—The author is concerned with the difficulty that in passing from the non-relativistic wave equation to the relativistic form, the interpretation of probability density $\psi\bar{\psi}$ as density of electric charge no longer holds good except as an approximation. By introducing a Weyl gauge scalar it is suggested that the original interpretation of $\psi\bar{\psi}$ can be restored. The argument leads to the conclusion that the field of an electron must be limited by a spherical surface whose radius agrees almost exactly with the classical electron radius. W. S. S.

2254. Slowing Down of Neutrons by Collisions with Hydrogen Nuclei. C. H. Westcott and T. Bjerge. *Cambridge Phil. Soc., Proc.* 31. *pp.* 145–152, *Jan.*, 1935.—The discovery of Fermi and his collaborators, that neutrons are much more readily captured by various atoms, *e.g.*, silver, when their kinetic energies originally of the order of 10^6 eV, have been reduced by collisions with hydrogen nuclei, is confirmed. The process of slowing down of the neutrons is studied in some detail, and the nuclear cross-section for collisions with hydrogen nuclei is determined for the primary neutrons and for the slow neutrons which are readily captured by silver atoms. The nature of the " gas " of slow neutrons is also discussed, but it is not found possible to reach a definite conclusion as to the energy of the neutrons concerned. AUTHORS.

2255. Annihilation of Very Rapid Positrons on Passage Across Matter. J. Solomon. *J. de Physique et le Radium*, 6. *pp.* 114–116, *March*, 1935.—A simple relation is established between the probability of the annihilation of a very rapid positron with an intra-atomic electron with emission of a single photon, and the probability of the habitual photoelectric effect relative to the ejection of an electron of energy equal to that of the position considered. The process in question is considered in relation to the absorption of cosmic positrons by matter. J. J. S.

2256. Production of Pairs of Positive and Negative Electrons by Collisions of Particles. L. Nordheim. *J. de Physique et le Radium*, 6. *pp.* 135–136, *March*, 1935.—The semi-classical method of v. Weizsäcker [see Abstract 2876 (1934)] is applied to the problem of the production of pairs of positive and negative electrons by the collision of an electron of very great energy (cosmic ray electron, for example) with a nucleus. The effect is shown to be much more feeble for electrons than for γ-rays of the same energy: in the case of lead the factor of difference is 1/140. H. L. B.

2257. Polarisation of Electrons Scattered by Crystals. V. Weisskopf. *Zeits. f. Physik*, 93. 9–10. *pp.* 561–581, *Feb.* 14, 1935.—It is shown that the reflection of electrons at a potential barrier may lead to a partial polarisation of the reflected electronic beam, and that when an unpolarised electron beam is scattered by a crystal certain special reflections at lattice planes occur, in which the secondary rays exhibit a relatively intense amount of polarisation. These reflections are those for which in consequence of the symmetry of the crystal the Bragg reflection condition is simultaneously fulfilled for several lattice planes. It is not to be expected that there will be an observable amount of polarisation for a reflection from one plane. H. L. B.

2258. Kirchhoff's Diffraction Problem for Electron Waves. A. Rubinowicz. *Acta Physica Polonica*, 3. *pp.* 143–163, 1934. *In German.*—For the purpose of arriving at a complete theory of the Stern-Gerlach effect the diffraction phenomena of Dirac's electron waves are investigated from the point of view of Kirchhoff's theory of diffraction, in the first instance for cases where no external fields are present. The calculations are carried out analogously to those in the corresponding problem in optics and the results are compared and discussed. H. L. B.

2259. Scattering of Fast Electrons by Crystals. N. Pisarenko. *Phys. Zeits. d. Sowjetunion*, 7. 1. *pp.* 26–42, 1935. *In English.*—The inelastic scattering of fast electrons by a crystal lattice is investigated theoretically, taking into account : (1) the excitation of the electronic shells of the lattice atoms by the use of Frenkel's method of " excitation waves," and (2) the heat motion of the crystal. It is shown that, to a good approximation, the crystal structure does not influence the inelastic scattering, and that the effect of the heat motion can be represented by the usual Debye heat factor. AUTHOR.

2260. Electron Diffraction as a Method of Research. G. P. Thomson. *Nature*, 135. *pp.* 492–495, *March* 30, 1935.—Brief account of electron diffraction as a method of research. Investigation by electron diffraction differs from that with X-rays in that the former often requires only a few seconds exposure; also owing to the low penetrating power, surface phenomena may be conveniently examined. The method may be applied to (1) identification of oxides and rusts and observation of their rate of growth, (2) examination of perfection of crystal surfaces, (3) determination of inner potentials of ionic crystals, (4) demonstration of the amorphous nature of the Beilby layer, (5) investigation of the behaviour of lubricants such as graphite. Adsorbed gas layers appear to have no effect on the diffraction patterns observed and it is supposed that the layers are removed under the electron bombardment the energy of which is about 30,000 V. F. C. C.

2261. Inner Potential of Zincblende. S. Miyake. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers. No.* 562. *pp.* 216–224, *March*, 1935. *In English.*—The ambiguity left in the assignment of the orders of reflections to the kathode-ray spectra due to the cleavage face of zincblende is removed, and as a result, the fact that the anomalous phenomenon takes place in the lower orders for zincblende also is confirmed. As the normal value of the inner potential of this crystal, 12·18 volts is obtained. [See Abstract 1838 (1935).] AUTHOR.

2262. Electronic Waves. M. Steck. *Zeits. f. Physik*, 94. 3–4. *pp.* 211–219, *March* 19, 1935.—This investigation deals with the theoretical relationships which exist between the electromagnetic wave motion of light and the electronic waves, and its object is to obtain conclusions respecting the physical nature of the latter. §1 considers the de Broglie relationship and the differential equation of the mass variability of electrons, and §2 discusses the properties of the electronic waves. It is shown that electronic waves produce analogous effects to X-rays and γ-rays, and support is given to de Broglie's assumption that electronic waves are a species of h.f. electromagnetic wave radiation which is propagated with a velocity exceeding that of light. H. H. Ho.

2263. Focusing of Narrow Electron Beams in Vacuo. A. Bouwers. *Physica*, 2. *pp.* 145–154, *March*, 1935. *In English.*—The focusing of electron beams by means of electric fields is studied after discussion of the dispersion caused by space-charge. The basis for the calculations was a thin band-shaped beam, but conclusions are drawn with respect to circular beams. The focal distances for the axially symmetrical fields (circular beams) are always twice the values found for flat beams, as long as space-charge effect is negligible. The method followed for calculating focal distances is essentially the application of $1/f = 1/f_1 + 1/f_2 \cdots\cdots$ which holds good for short "lenses." This leads to simple formulæ of which $1/f = 1/2\int_{x_1}^{x_2}\phi''/\phi \cdot dx$ is the most general one. In special applications simpler relations are deduced. For the *Einzellinse* [see Abstract 1591 (1933)] good agreement with experimental results is found. Critical conditions are discussed for the focusing of a flat beam, with appreciable dispersion by space-charge. AUTHOR.

2264. Conversion of Light Pictures into Electron Images. W. Schaffernicht. *Zeits. f. Physik*, 93. 11–12. *pp.* 762–768, *Feb.* 26, 1935. —A method described by Brüche [see Abstract 299 (1934)] is utilised to convert an optical picture projected on to a photo-sensitive K surface into an electron image by focusing the photoelectrons emitted with a magnetic lens. The sensitive layer is formed on a silver backing and the image is thrown on to it from the side. The loss in intensity due to energy exchange at the photo-sensitive surface may be compensated by a suitable choice of accelerating potential. H. J. H. S.

***2265. Suitability of Transparent Photo-Kathodes for Electron-Optical Systems. W. Kluge.** *Zeits. f. Physik*, **93.** 11–12. *pp.* 789–791, *Feb.* 26, 1935.—The work of Holst and others on red-sensitive Cs kathodes [see Abstract 1978 (1934)] is briefly reviewed. An apparatus is described which has a Cs photo-sensitive surface about 40 mμ thick and with a transmission factor of about 25 % ; an image projected by an optical system on to one side of this surface gives rise to photoelectrons on the other and these are focused by means of a magnetic lens on a fluorescent screen. H. J. H. S.

***2266. Method of Viewing and Recording Induction-Coil Transients with the Kathode-Ray Oscillograph. G. A. Woonton.** *Canad. J. of Research*, **12.** *pp.* 272–275, *Feb.*, 1935.—A description is given of apparatus for generating the timing voltage for a kathode-ray oscillograph and of the means adopted for the synchronisation of this voltage wave with transients produced by induction coils under the conditions maintained by physiologists when stimulating nervous tissue. The type of apparatus finally adopted is essentially a combination of that of McFarlane [see Abstract 5464 (1933)] and Turner [see Abstract 1344B (1931)] applied to a sweep oscillator. A rotary commutator is fitted with an additional synchronising wheel besides those usually employed for making and breaking the primary current of the induction coil, and suppressing undesired transients in the secondary circuit. The grid of the sweep oscillator valve is biased negatively to prevent any discharge; but for a small fraction of a second when contact is made on the synchronising wheel the grid bias is neutralised and a discharge can take place, after which the grid again takes control. Since by this means the transient appears at a definite time after the spot starts its sweep across the screen, perfect retracing is possible. Amplitude and frequency of the sweep oscillator are controlled in the usual manner. A. W.

See also Abstracts **1892, 1908, 2158, 2213, 2215, 2216, 2218, 2267, 2286, 2304.**

ELECTROSTATICS.

2267. Potential of Slit and Hole Diaphragms. W. Henneberg. *Zeits. f. Physik*, **94.** 1–2. *pp.* 22–27, *March* 12, 1935.—A knowledge of the potential fields in the neighbourhood of slits and small holes is becoming of increasing importance in the development of geometrical electron-optical devices. The potential on the axis of a slit and of a small hole is calculated and the equipotential lines in the neighbourhood of the apertures are plotted for two simple cases, firstly, when there is no field on one side of the aperture, and secondly, when the fields are the same on each side.

H. J. H. S.

See also Abstract **1926.**

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

2268. Change of Resistance of Magnetite in a Magnetic Field at Low Temperature. P. A. Chalileew. *Phys. Zeits. d. Sowjetunion*, **7.** 1. *pp.* 108–114, 1935. *In German.*—The electrical resistance, *r*, of natural magnetite is found to decrease in magnetic fields of strengths 3000, 7000, 8750 and 11,000 gauss at temperatures between 80° and 120° Abs. The relative decrease of resistance, *dr/r*, is a maximum at 111·4° Abs. at which it has the value 8 % in a field of strength 9000 gauss. It is suggested that, at about 111° Abs., magnetite experiences a transformation analogous to that found in ferromagnetics in the region of the Curie point. J. S. G. T.

2269. Crystal Structure and Electrical Properties. Part V. Conductivity Surfaces of Bi Crystal. O. Stierstadt. *Zeits. f. Physik*, 93. 9–10. *pp.* 676–691, *Feb.* 14, 1935.—Extends previous work on the form of the conductivity surfaces [see Abstract 2192 (1934)] to the general case when the magnetic field may make any angle with the direction in which the resistance is measured. W. S. S.

See also Abstracts 2225, 2226.

MAGNETISM AND ELECTROMAGNETISM.

2270. Ferromagnetism of Pt-Cr Alloys. E. Friederich and A. Kussmann. *Phys. Zeits.* 36. *pp.* 185–192, *March* 15, 1935.—The hardness, density and electrical resistance of the Pt–Cr alloys are briefly summarised. The magnetic properties of the series are described in a number of curves and the results of an X-ray examination of certain members of the series are recorded; the formation of a compound $PtCr_3$ is indicated. Alloys containing between 22 and 48·5 atomic % Cr are ferromagnetic and the maximum magnetisation is 3000 and is given by a 30 atomic % Cr alloy. An attempt is made to explain the properties of the alloys on an atomic basis. H. J. H. S.

2271. Magnetic Properties of Ferromagnetic Materials on Breaking Circuit. G. K[illegible]ling. *Ann. d. Physik*, 22. 4. *pp.* 402–420, *March*, 1935.—The instantaneous magnetic induction developed by an inducing a.c. under certain simple conditions is calculated and a series of experiments is made in an endeavour to verify the conclusions deduced. It is shown that the stationary flux in a ferromagnetic body breaks down more rapidly than is indicated by measurements of the static initial permeability; from measurements taken during the period in which the induction is falling off exponentially, the effective permeability may be deduced. In the time 0·015 to 0·01 sec. after the cessation of inducing force, the effective permeability is independent of the time and has a value of about 15–20 % less than that of the static initial permeability. H. J. H. S.

2272. Paramagnetism of Cobaltous Ion in Very Dilute Solution. R. Mercier. *Ann. de Physique*, 3. *pp.* 201–269, *March*, 1935.—A detailed account of work previously reported in brief [see Abstract 1643 (1933)]. After a clear account of the theory of the subject full details of the method of measuring the susceptibility of solutions 0.001–0.02-*N* of $CoCl_2$, $6H_2O$ in methyl alcohol at temperatures 177–203° Abs. are given. The atomic moment, independent of concentration, diminishes with temperature; near the melting point of methyl alcohol only the spin of the electrons seems to be magnetically active. This is probably due to a Stark effect produced by the atoms of the solvent on the Co^{++} ions. The greater applicability to the present case of the theory of magnetism of crystals is probably connected with the tendency of Co to form complexes with coordination number 6. C. A. S.

2273. Diamagnetic Susceptibilities of Palladium Salts. R. B. Janes. *Am. Chem. Soc., J.* 57. *pp.* 471–473, *March*, 1935.—The magnetic susceptibilities of 14 Pd^{II} salts, of one Pd^{III} and one Pd^{IV} salt were determined by Gouy's method at the ordinary and liquid air temperatures. Contrary to the Hund rule all are diamagnetic, implying that the lowest level of the metallic ion is one of zero resultant spin; or perhaps that the metallic ions lie close enough together for the spins of neighbouring ions to couple so as to give a zero resultant spin; or in the case of salts such as $K_2Pd(CN)_4$ it may be due to the 4 (CN) lying in one plane. C. A. S.

2274. Magnetic Susceptibility of Tetraphenylrubene and Its Dissociating Oxide. L. Enderlin. *Comptes Rendus*, 200. *pp.* 912–914, *March* 11, 1935.—The magnetic susceptibility of tetraphenylrubene is found to be $\chi_m = -3440.10^{-7}$, which agrees to within 2 % with the additive value calculated from the ordinary formula for this compound, if Pascal's polynuclear moduli of correction are assumed. It is concluded that, in the solid state and under ordinary conditions, this compound does not possess the properties of a biradical. The value for the dissociating oxide is $\chi_m = -3525.10^{-7}$. These results, which support those of thermochemical measurements, indicate that the oxygen of the oxide is linked to the organic substrate by normal valencies. T. H. P.

2275. Magnetic Susceptibility of Lithium Hydride. Diamagnetism of Ionic Crystals. S. Freed and H. G. Thode. *J. Chem. Phys.* 3. *pp.* 212–215, *April*, 1935.—The magnetic susceptibility of crystalline lithium hydride was measured at room-temperature (300° Abs.) and at 78° Abs. and was found to be -4.60×10^{-6} per mole with practically no temperature coefficient. One theoretical prediction deviates from the experimental value by 90 % and another by 130%. This discrepancy is interpreted as due mainly to a paramagnetism independent of the temperature which is present in all crystals and which has not been included in the calculations. AUTHORS.

2276. Electrical Magnitudes. J. B. Pomey. *R.G.E.* 37. *pp.* 179–185, *Feb.* 9, 1935.—Discusses electric force and Maxwell's electric displacement and the analogous magnetic magnitudes in the light of electron theory and shows that if the electric force and electric displacement are magnitudes of the same nature, the metric of empty space must be Euclidean. W. S. S.

2277. Eddy-Current Loss in Tube in Axial Alternating Magnetic Field. N. W. McLachlan and A. A. Meyers. *Phil. Mag.* 19. *pp.* 846–850, *April*, 1935.—The analysis contained in a previous paper [see Abstract 5255 (1934)] is here extended so that the restriction that the inner radius of the tube is small compared with the outer is removed. J. S. G. T.

***2278. Magnetic Measurements as an Aid to Dressing Treatment of Iron Ores. L. Kraeber.** *Naturwiss*, 23. *pp.* 160–164, *March* 8, 1935.—The published results on the magnetic properties of powdered magnetite are criticised and the conditions necessary for comparable results are elucidated. An apparatus is described for measuring the magnetic susceptibility of iron ores; it comprises a sensitive balance and a small, powerful electromagnet. Susceptibilities of the order 1×10^{-6} are measurable. The magnetic changes which occur on roasting and dressing ores are briefly outlined and the value of magnetic measurements during these treatments is illustrated. H. J. H. S.

***2279. Induction Apparatus for Measurement of Small Magnetic Moments. E. Thellier.** *Comptes Rendus,* 200. *pp.* 736–738, *Feb.* 25, 1935.—Describes a modified form of Grenet's apparatus [see Abstract 2285 (1933)] in which a pair of Helmholtz coils replaces the solenoidal induction winding, thereby allowing easier access to the specimen, which can be turned through 180° instead of being withdrawn. A second pair of similar coils, placed coaxially one on each side of the Helmholtz coils and connected in opposition to them, almost completely eliminates the disturbing effect of variations in the earth's field and gives a stable zero. A sensitivity of 20 mm. deflection per c.g.s. (e.m.) unit of magnetic moment is obtained, and, as large specimens can be used, magnetisations of the order of 10^{-4} e.m.u. can easily be measured. C. E. W.

***2280. Large Permanent Magnet for β-Ray Spectroscopy. J. Surugue.** *J. de Physique et le Radium,* 6. *pp.* 94–98, *March,* 1935.—The construction of a large permanent magnet for β-ray spectroscopy, similar to that designed by Cockcroft, Ellis and Kershaw [see Abstract 3457 (1932)] is described. With a pole-gap of about 6 cm. the field is uniform to 1 in a 1,000 for a β-particle of $H\rho$ up to 20,000. Fields of 1,430 gauss and 780 gauss are obtained with small and large pole-pieces respectively. Theoretical investigation is made of the dispersion and the losses of the magnet assuming plane parallel pole-pieces and the results are shown to be in good agreement with experiment. F. C. C.

***2281. Simple Electromagnetic Balance. R. M. Archer.** *Journ. Sci. Instruments,* 12. *pp.* 105–108, *April,* 1935.—In this apparatus the pull of a solenoid is measured by a simple lever balance in combination with a spring balance, hysteresis errors being reduced by suppressing lateral movement of the core and restricting axial movement to a very small amount. Applications to current-bearing coils and to electromagnets may be made. AUTHOR.

***2282. Demonstration Oscillograph Outfit. H. Lloyd.** *Journ. Sci. Instruments,* 12. *pp.* 119–122, *April,* 1935.—The article describes the construction of a portable oscillograph equipment which has been in use for several years for class demonstration work on the lantern screen. Its advantages are its inexpensiveness, its ability to project large diagrams, good visibility, and its adaptability to the reproduction of transients and characteristic curves, as well as periodic quantities. AUTHOR.

See also Abstracts 1909, 1930, 1946, 1969, 1990, 1991, 2176.

MEDICAL RADIOLOGY AND ELECTROLOGY.

2283. Influence of Wave-Length on Lethal Action of H.F. Fields. N. N. Malov. *Acad. Polonaise Sci. et Lettres, Bull.* 8–9*A*. *pp.* 387–390, *Oct.-Nov.,* 1934. *In German.*—In previous work Szymanowski has shown that as the wave-length of a h.f. electric field is increased the applied voltage should be increased, if the time for lethal action remains constant. It is suggested that this conclusion is due to a neglect of complicating factors caused by the presence of a body in the field. A formula is developed for a simple case, which shows only very small variations of voltage with wave-length. J. E. R.

2284. Theory of the H.F. Condenser Field Method. H. Dänzer. *Hochfrequenztechn. u. Elektroakustik,* 45. *pp.* 85–87, *March,* 1935.—The question of heat generation in a slab of dielectric material placed in a h.f. electric field, is discussed mathematically from the point of view of the

Wagner theory of dielectric losses. The existence of a "dispersion" point, a frequency at which the conductivity rises very rapidly, is demonstrated. Assuming a fixed potential between the plates the value of the "dispersion" frequency, calculated by this method agrees to a first approximation with the value calculated by the simpler method of Pätzold. J. E. R.

2285. Electro-Kephalograms of Humans. H. Berger. *Naturwiss.* 23. *pp.* 121–124, *Feb.* 22, 1935.—The presence of oscillating electrical potentials, apparently connected with brain activity has been investigated in the case of animal subjects for many years, and recently the work has been extended to humans. The usual method of obtaining records is by means of electrodes placed either on the surface of the head or subcutaneously, and connected to an amplifier or galvanometer. In the present work an oscillograph has been used, and comparison with the older method shows a great improvement. A number of examples of recorded electro-kephalograms of normal and abnormal subjects are shown side by side with electro-cardiograms. The effects of stimulation are clearly marked, there being a noticeable lag of the order of 0·5 to 1·0 sec. between the moment of stimulation and the change in the electro-kephalogram. The psychophysical basis of the observed data is discussed. J. E. R.

***2286. Kathode-Ray Oscillograph Amplifier for the Measurement of Action Currents. F. Hehlgans.** *Zeits. f. techn. Physik,* 16. 2. *pp.* 42–51, 1935.—A detailed description is given of an amplifier oscillograph system which can be used for a variety of biological and clinical measurements. For use as an electro-cardiograph, a two-valve amplifier energises a kathode-ray oscillograph with crossed electrostatic fields, batteries being used for h.t. and l.t. supplies. The "dark current" of the amplifier is balanced on the oscillograph by a variable potential on the opposing plates. It is shown that the amplification of the system is independent of the input frequency from 3 to 1000 cycles. The total amplification of the order of 5×10^4, is almost linear up to an input of 2·0 mV. For many physiological measurements a much higher amplification is required, and for this purpose a further valve (diode) is introduced into the amplifier, acting as a variable high resistance in the output circuit. This simple arrangement involves the use of an insulated filament battery, but this difficulty is overcome in a modified form of the apparatus by means of an indirectly heated pentode valve. By means of a simple apparatus, in which the movements of the oscillograph beam are photographed on an ordinary kinematograph film, permanent records can be made. Examples of the results obtained are given. A short description is given of a compact form of the apparatus for hospital and research purposes. J. E. R.

***2287. Bursitis-X-Rays-High Frequency. W. R. Whitney.** *Gen. El. Rev.* 38. *pp.* 70–76, *Feb.,* 1935.—A short description is given of the production of bursitis resulting from calcareous deposits near the bursæ. Previous experimenters and clinicians have shown that these deposits can be removed by means of continuous local heat treatment. A number of physico-chemical explanations of the disappearance of the deposits are discussed and it is suggested that changes in solubility of the calcareous matter in the surrounding plasma may be an important factor. An apparatus is described in which electrical oscillations of frequency 1200 kc., with a power of 160 W, are produced by means of a 2-valve oscillator in a large coil. The latter can be used as a local applicator to heat internal tissues above normal blood temperature. Two case records, one of acute and one of chronic bursitis, are described, in which there is complete resolution of the deposits after a number of applications of the treatment. It is suggested that other pathological conditions involving calcareous deposits might respond to similar methods. J. E. R.

***2288. Radio-Frequency H.V. Apparatus for X-Ray Therapy. R. S. Stone, M. S. Livingston, D. H. Sloane and M. A. Chaffee.** *Radiology,* 24. *pp.* 153–159, *Feb.,* 1935.—In research work at California University in respect to nuclear disintegration a h.v. radio-frequency resonance transformer was developed, permitting peak voltages to be obtained from 700 kV to 1000 kV. X-radiation was developed on discharge and arrangements made to utilise such an apparatus for actual medical purposes. The schematic arrangement is illustrated and the X-rays are excited directly within the high vacuum transformer from a target attached to the transformer. The high voltages are entirely confined to the vacuum tank. The h.f. energy is provided by valves and the mechanical and electrical arrangements are discussed in detail. Treatment of patients is *via* suitable ports which may be four in number to allow several patients to be simultaneously treated, protection to operators being provided by 1·5 in. of lead covering the transformer tank. In operation the apparatus is very stabile and the criticism of this type of apparatus, on the score of high energy consumption, is hardly warranted since the cost of power is small relative to other charges of operation. All h.v. discharge is within the tank and harmless and, if by such discharge gas is liberated from the metal, this can be evacuated by connected pumps in a few seconds and replacement of parts is simple and inexpensive and made within a day. B. J. L.

2289. Spectrographic Measurement of Voltage Wave-Form of X-Ray Tubes. R. R. Newell. *Radiology,* 24. *pp.* 165–168, *Feb.,* 1935.—The efficiency of an X-ray tube is dependent upon the current and potential wave form. The author, in collaboration, has studied this by a stroboscopic method and later by a spectrographic-stroboscopic method employing the Seemann slit method. If the short-wave spectrum is recorded stroboscopically, then the readings represent, in time, the voltage variations in respect to time. The arrangement of the apparatus is illustrated and curves obtained, by reduction of the readings to rectangular coordinates, are shewn. B. J. L.

2290. Decomposition of Iodides by X-Rays and γ-Rays. Helen Q. Woodard. *Am. J. of Roentgenology and Radium Therapy,* 33. *pp.* 227–234, *Feb.,* 1935.—In a previous publication [see Abstract 2639 (1933)] data were given as to the decomposition of alkaline iodides in acid solution by X-rays and γ-rays. Further study has been made as to the factors influencing the decomposition. This is a function of the pH of the solution, but not directly proportional to it. The decomposition is dependent upon the nature of the acid solution owing to secondary effects. The formation of H_2O_2 in the solutions is not an important factor. The paper is largely one of data discussing the effect of the pH value, the effect of different acids, the concentration of iodide, the effect of the atomic number and the effect of quality and intensity of radiation. The reaction is considered unsuitable for the measurement of radiation, but confirms the theory of recombination of ions. The sensitivity of the solutions used to X-radiation excited between 165–200 kV is apparently independent of changes in quality corresponding to a change in filtration from 1 mm.

celluloid to 1·67 mm. Cu. The relative sensitivity of the solution used to X- and γ-rays is not the same. B. J. L.

2291. Relation between the Röntgen and the Erythema Dose. C. C. Lauritsen. *Am. J. of Roentgenology and Radium Therapy*, **33.** *pp.* 235–236, *Feb.*, 1935.—It is submitted that it is not possible, in general, for a given number of R units, to produce the same effects regardless of wave-length. Any effect, physical or biological, is dependent and produced by the energy actually absorbed. Such absorption depends upon the physical dimensions of the absorbing media, *i.e.*, whether absorption is of a narrow beam of X-rays in air, or of a wide beam in the interior of a large body, or of a wide beam in a superficial layer of a large body. The author illustrates the case of wave-lengths corresponding to 100 kV and 400 kV respectively, applied to the skin of a patient. He concludes, with Meyer, that it is not of advantage, but possibly harmful to use hard X- or radium-rays for superficial and semi-superficial lesions, unless other factors, as yet insufficiently known, form the deciding part in the problem. B. J. L.

2292. Dosage in Radiation Therapy. R. Paterson. *Brit. J. of Radiology*, **8.** *pp.* 155–162, *March*, 1935.—A general survey is made of the physical factors involved in X-ray and γ-ray therapy, with special reference to (*a*) quantity of radiation or dose, (*b*) quality of radiation, and (*c*) time of irradiation or intensity. For X-ray work the röntgen is now well established as the unit of dose, but in clinical practice the factors of backscatter and radiation from other ports of entry must be taken into account when assessing total skin dose. The use of depth dose measurements and charts is essential for accurate work. In γ-ray therapy, no unit is as yet internationally accepted, but the main problem resolves itself into the question of the method of distributing the Ra so as to produce homogeneous and measurable radiation over an area or volume. The necessity for precise statement of quality of radiation is uncertain until definite evidence is forthcoming on the question of a differential biological effect between hard and soft radiations. Probably the most important variable from a clinical point of view is the time factor, the permutations of which are almost infinite. Evidence shows that in general, as the over-all period of exposure is prolonged, the dose required to produce any given biological effect increases. A number of clinical experiments are described, illustrating the effects of various methods of fractionating the total dose. J. E. R.

2293. Action of Soft X-Rays on Bacteria. B. S. Levin and I. Lominski. *Comptes Rendus*, **200.** *pp.* 863–865, *March* 4, 1935.—Twenty types of microbes were exposed for periods varying from 1 sec. to 8 min. to soft X-rays of high intensity. A special tube working at 20 kV. and 20 mA., and with a window of Al 15 μ thick, allowed the specimens to be irradiated at a distance of 30 mm., the dosage rate being 1,500 *r* per sec. It was found difficult to define with any accuracy the resistance of the microbes to X-rays, but a tentative arrangement of the types investigated in order of sensitivity is suggested. The microbes which received a lethal dose of radiation showed important morphological changes, these phenomena appearing several minutes after the end of the irradiation. Sub-lethal doses produce a latent period in the development of the specimens, followed after periods up to five days, by a phase of rapid development; the latent period increases as the dose approaches the lethal dose. Peculiarities in development are noted after sub-lethal doses. The age of the culture, between the limits of 18 hr. and 10 days, and the number of germs in the specimen irradiated do not influence the results. J. E. R.

2294. Biological Response to γ-Rays as a Function of Intensity of Radiation. F. G. Spear and L. G. Grimmett. *Brit. J. of Radiology*, 8. *pp*. 231–234, *April*, 1935.—In a previous paper [see Abstract 4276 (1933)] the authors described some effects of γ-rays from a 4 gm. Ra unit on tissue cultures. At that time no method of measuring the quantity of radiation was available and the intensities were calculated. In the present work these calculations have been compared with measurements made with a Sievert condenser dosemeter. It is shown that the relative values agree to within 2 %, but that the observed values are 24 % higher than the calculated. It is found that the optimum intensity for reducing mitosis in tissue cultures is in the region of 77 Imc. J. E. R.

2295. Absorption of Radon by Human Skin. R. Wagner. *Akad. Wiss. Wien, Ber*. 143. 2*A*. 8–10. *pp*. 521–531, 1934.—The paper describes a series of experimental determinations, under various conditions, of the permeability of the human skin to radon when the body is bathed in air or in water containing radon. W. E. P.

See also Abstracts 2087, 2266.

OSCILLATIONS.

2296. Characteristics of Gasfilled Hot-Kathode Valves. I. Runge. *Zeits. f. techn. Physik*. 16. 2. *pp*. 38–42, 1935.—An experimental and theoretical investigation is made of the effects of increasing gas pressure (mercury vapour or argon up to 0·2 mm. Hg.) on the characteristics of diode and triode valves. The measuring system is similar to that of Koch, in which the valve current to be measured is compensated by varying the grid potential of another valve placed in parallel. Measurements at very low pressures could be made by inserting the valve in liquid air. On the assumption that the positive ions in a gasfilled triode act in the same way as a positive potential on the grid it is possible to derive true high vacuum characteristics for various conditions. Discrepancies observed at very low pressures can be traced to discontinuities in the distribution of the ion layers. It is shown that the valve current depends on the uniformity of the space distribution of the ions. J. E. R.

2297. Effect of Electrical Waves on Heterogeneous Catalysis in Solutions. E. Wilke and H. Ganser. *Kolloid Zeits*. 70. *pp*. 132–135, *Feb*., 1935.—It is shown, that the application of an electrical alternating field ($\lambda = 50$ m.) on a malt diastase starch-solution leads to a decrease in the catalytic action of diastase ; that for the catalytic decomposition of H_2O_2 by Ag sol there is a change in effect for electrical waves of $\lambda 200$; that the action of electrical waves on the catalysis of H_2O_2 by Pt sol is very small ; that visible light lowers the speed of catalysis of H_2O_2 by Ag sol ; and that the catalysis of H_2O_2 by ions is not influenced by electrical waves. It is pointed out that visible light and electrical waves both influence the catalyst and not the catalysis [see Abstract 421 (1934)]. J. K.

See also Abstracts 2203, 2220, 2222, 2283, 2286, 2317.

PHOTOELECTRICITY.

2298. Red Threshold of the Internal Photoelectric Effect in Semi-Conductors. J. H. de Boer and W. C. van Geel. *Physica,* 2. *pp.* 286–298, *April,* 1935. *In German. English Abstract.*—The energy value, U, which can be found from the dependence of semiconduction on the temperature, is in general not equal to the energy value, $h\nu_r$, of the red threshold of the photoelectric conduction of the same compounds. According to the theory of Wilson [see Abstract 1328 (1932)], $h\nu_r = 2U$, an equation that is no more in agreement with the experimentally known values than the equation $h\nu_r = U$. There are several objections to Wilson's theory, some of which may be overcome by different treatment of the problem, whilst another, *viz.,* the treatment of the equilibrium (bound electrons $\rightleftarrows$ free electrons + "holes") as an equilibrium in a homogeneous phase remains unsolved by the present method. The mechanism of the semiconduction must be imagined to consist of an ionisation of internally adsorbed atoms. The alterations in the binding energies of these atoms and of the ions in this process of ionisation must also be taken into account. This is done by means of potential curves from which, among other things, can be deduced: $h\nu_r \neq U$. AUTHORS.

2299. Selective Photoelectric Effect. P. I. Lukirsky and J. L. Hurgin. *Phys. Zeits. d. Sowjetunion,* 7. 1. *pp.* 99–107, 1935. *In German.*—In general, the intensity of the external photoelectric effect is determined by the intensity of the electromagnetic field beneath the surface of the metal. It is now shown that in the case of the alkali metals, Au and Pt, the photoelectric intensity-wave length curves show no selection maximum if the intensity of the effect is referred to the electromagnetic energy density beneath the metal surface. The so-called selective photoelectric effect is attributable to a particular change of intensity of the electromagnetic field dependent upon the wave-length and state of polarisation of the incident light. J. S. G. T.

2300. Photoelectric Effect of a Layer of Silver Deposited on Nickel. N. Fedeneff. *Phys. Zeits. d. Sowjetunion,* 7. 1. *pp.* 58–65, 1935. *In French.*—Measurements are made of the work function of electrons for thin layers of silver deposited on nickel. As the thickness of the layer is increased the value increases above the value (3·7 V.) for pure nickel, reaching 4·2 V. for a thickness of the order of 3·5 Å. As the thickness is still further increased, the value falls off again to the value (3·9 V.) for silver. This is in agreement with measurements upon the differences of the contact potentials. The results make it possible to construct a potential curve for the neighbourhood of the surface of nickel covered with layers of silver of different thicknesses. L. A. W.

2301. Work of Escape of Electrons from Metals into Dielectrics. N. Kalabuchow. *Zeits. f. Physik,* 93. 9–10. *pp.* 702–703, *Feb.* 14, 1935. —The photoelectric threshold value is measured for electrons that escape from K and Pt into NaCl. It is found that the same value (2·28 V.) is obtained for each of these cases. This value coincides with that obtained earlier for Ag. H. L. B.

2302. Crystal Photoelectric Effect with Naturally Coloured Rock-Salt Crystals. L. Grošev. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 217–220, *Feb.* 1, 1935. *In German.*—Unhomogeneously coloured natural rock-salt crystals are provided with two electrodes, one of which is earthed and the other connected to an electrometer. Illumination, either from the side or longitudinally through a hole in one of the electrodes, is observed to give rise to a reproducible e.m.f. of a few tenths of a volt. The effect is ascribed to the diffusion of electrons from regions of higher concentration to regions of lower concentration. Positive results cannot be obtained with artificial KCl and KBr crystals. L. A. W.

2303. Photoelectric Properties of the (100) and (111) Faces of a Single Copper Crystal. N. Underwood. *Phys. Rev.* 47. *pp.* 502–505, *March* 15, 1935.—The two faces were cut from the same single crystal, and etched to remove the broken surface pieces and to expose only crystal facets which were parallel to the geometric boundaries in question. Care was taken to prevent any contacts between the prepared planes and foreign objects. The two specimens were heated simultaneously by electronic bombardment at various red-heat temperatures for over 1,500 hours in a good vacuum. The photoelectric thresholds were measured by the use of filters as the outgassing proceeded. During readings, the pressure was less than 5×10^{-8} mm. Hg. After 500 hours of outgassing the threshold wave-lengths were approximately 2,540 Å for the (111) face and 2,200 Å for the (100) face. The results show that the etching produced by evaporation should be avoided in such an experiment. AUTHOR.

2304. Secondary Kathode Rays Expelled from Metals by Molybdenum Kα Radiations. H. R. Robinson and C. J. B. Clews. *Roy. Soc., Proc.* 149*A*. *pp.* 587–595, *April* 10, 1935.—The energies of the photoelectrons expelled from targets of Au, Pt, Ag and Cu by Mo Kα rays have been measured in the magnetic spectrometer. The results are compared with those of Kretschmar for the same elements [see Abstract 2601 (1933)] and briefly discussed in their relation to the absolute values of X-ray wave-lengths and the principal atomic constants. AUTHORS.

2305. Electrical and Optical Behaviour of Semi-Conductors. Photoelectric Conduction in Natural Lead Chromate Crystals. G. Kapp. *Ann. d. Physik,* 22. 3. *pp.* 257–280, *March,* 1935.—The increases of conductivity observed when natural lead chromate crystals are illuminated for periods of the order of 1 sec. are due to secondary processes, the increase of current being proportional neither to the voltage nor to the light intensity and the effect showing a marked lag. By using very short periods of illumination (rapidly interrupted light) it is found possible to isolate the primary effect. Frequencies of interruption from 800 down to 100 per sec. are investigated by Schönwald's a.c. method, while for lower frequencies photographic registration with the aid of an electrometer is used. The "life-period" of the photoelectrons (about 10^{-4} sec.) is found to be independent of light intensity and applied voltage. Even with a voltage of 2000 V per cm. no indication of saturation is observed, the photoelectric yield being only about 1/1000 of the quantum equivalent. The spectral distribution of photoelectric sensitivity is determined both in terms of incident light energy and (by correction for measured transmission) in terms of absorbed energy. L. A. W.

2306. Mechanism of the Photovoltaic Potential of Plates of Oxidised Copper. J. Roulleau. *Comptes Rendus,* 200. *pp.* 920–922, *March* 11, 1935.—Experiments on electrodes of Cu_2O in aqueous solutions indicate that in the absence of a blocking layer the photovoltaic effect connected with a photolysis of water [see Abstract 2643 (1932)] is predominant. No appreciable electronic photo-potential is produced unless the electrode is specially treated so as to form a blocking layer at its surface. The photo-potential is then of the same order of magnitude both in aqueous solutions and in organic liquids rendered conducting by solution of KI the curve of spectral sensitivity having a maximum at about 4700 Å and a form like that obtained for ordinary solid Cu_2O cells. With electrodes of Cu covered with a layer of Cu_2O both types of process (photovoltaic and electronic) occur simultaneously and independently. An electronic effect is never observed with electrodes of Cu covered with a layer of CuO. L. A. W.

2307. Photosensitive Dyed Electrodes. Cécile Stora. *Comptes Rendus*, 200. *pp*. 1034–1037, *March* 18, 1935.—Experiments are described (with Nile blue, methylene blue, and phenosafranine as the dyes) to determine whether (*a*) a photosensitive dyed platinum electrode behaves as an inert electrode towards a reducer in an oxidation-reduction medium, and (*b*) there is a relation between the photopotential and the proportion of dye reduced in the dyed layer. The results indicate that (*a*) is the case, and (*b*) that it is possible to obtain titration curves by means of such dyed electrodes. [See Abstract 1878 (1935).] C. A. S.

***2308. Selenium-Sulphur Rectifier Photoelectric Cell. G. P. Barnard.** *Phys. Soc., Proc.* 47. *pp*. 477–500; *Disc.*, 500–501, *May* 1, 1935.—The paper describes a method by which a new selenium-sulphur rectifier photoelectric cell may be constructed, and gives the results of the first part of a full investigation of the physical behaviour of these new cells. The results are related to the details of construction of the cell, so as to show how far they support the theories of A. H. Wilson and of Frenkel and Joffé. A number of simple equations expressing the performance of the cell have been deduced. AUTHOR.

See also Abstracts 2070, 2071, 2072, 2073, 2074, 2223, 2224, 2265.

PIEZOELECTRICITY.

2309. Laws of Electric Charges Set Free by Torsion of Quartz. Ny Tsi-Ze and Tsien Ling-Chao. *Comptes Rendus*, 200. *pp*. 732–733, *Feb*. 25, 1935.—The quantity of electricity set free on the inner and outer walls of a quartz cylinder subjected to a couple C is given by the formula $Q = klC/d_o(d_o - d_i)$, where k is a constant having the value $9{\cdot}3 \times 10^{-8}$ c.g.s. electrostatic units and l, d_o, d_i are respectively the length and external and internal diameter of the cylinder. Tawil has given a different formula $Q = KlC/\pi(R^2 - r^2)$ [see Abstract 513 (1935)]. The two formulæ represent experimental results about equally well when the ratio d_i/d_o does not differ much from 2/3, but experiments with cylinders for which the ratio ranged from 0·23 to 0·82 showed that the value of K in Tawil's formula varied from 0·086 to 0·128, while the value of k in the formula proposed by the authors was practically constant, only varying between the limits $9{\cdot}2$ and $9{\cdot}4 \times 10^{-8}$. [See also Abstracts 3434 (1934) and 514 (1935).] A. W.

2310. Liberation of Electricity by the Torsion of Quartz. E. P. Tawil. *Comptes Rendus*, 200. *pp*. 1088–1090, *March* 25, 1935.—Reasons are given for not regarding as piezoelectric in character the phenomenon of electrification of quartz by torsion, termed by the author strephoelectricity [see Abstract 3434 (1934)]. J. S. G. T.

2311. Examination of Vibrating Quartz by Polarised Light. Pan Tcheng Kao. *Comptes Rendus,* 200. *pp.* 563–565, *Feb.* 11, 1935.—The quartz plate, piezoelectrically maintained in vibration, is viewed in the direction of the optic axis under polarised light, passed through the plate twice in opposite senses, as in Norremberg's method, in order to compensate the optical rotation, and secure extinction when the plate is at rest. When the plate vibrates, coloured spots appear. The patterns formed by the spots depend on the modes of vibration, and were regular in a few only of the plates examined. A study of the patterns leads to the conclusion that plates are not necessarily homogeneous, even when they pass the usual optical tests, and that the presence of very complicated modes does not exclude the simpler ones. [See also Abstract 3216 (1931).] P. V.

2312. Oscillations of Hollow Quartz Cylinders. Ny Tsi-Ze and Tsien Ling-Chao. *Comptes Rendus,* 200. *pp.* 565–567, *Feb.* 11, 1935.—Hollow cylinders having their generators parallel to the optic axis could be made to vibrate in 4 distinct modes. Transverse radial mode, of frequency $255/d$ kc/s., d being the wall thickness in cm.; transverse circular mode in 3 segments, at $263/c$ kc/s., c being 1/3 of the mean circumference in cm.; longitudinal vibration along the axis, at $310/l$ kc/s., l being the axial length in cm.; torsional vibration about the axis, at $220/l$ kc/s. The first two modes were demonstrated in a Norremberg apparatus. The frequencies found for the last two were in excellent agreement with the accepted, statically determined values of the moduli of elasticity and rigidity. The use of hollow quartz cylinders for frequency standards is suggested. P. V.

2313. Motion of a Bar Vibrating in Flexure. W. P. Mason. *Acoustical Soc. of America, J.* 6. *pp.* 246–249, *April,* 1935.—In this paper a complete theoretical solution is given for a bar vibrating in flexure taking account of rotary and laterial inertia. The solution shows that the frequency of a bar free to vibrate on both ends, is asymptotic to the frequency given by the usual solution, neglecting rotary inertia, when the ratio of width to length is small, and approaches the frequency of a bar in longitudinal vibration when the width becomes comparable to the length. The theoretical frequencies have been compared with the published results of Harrison [see Abstract 520B (1928)] on the frequency of a quartz crystal vibrating in flexure, and have been found to agree within 1 % for a crystal whose width is less than half its length. AUTHOR.

See also Abstract 2156.

THERMIONICS.

2314. Thermionic Emission from Platinum in Bromine and Chlorine Vapours. S. Kalandyk. *Acta Physica Polonica,* 3. *pp.* 165–178, 1934. *In German.*—A detailed description is given of the experimental arrangement by which the thermionic emission of Pt in a rarefied atmosphere of Br_2 is determined. Results indicate that, for high temperatures, the emission from the glowing Pt is simply a heat effect, probably due to emission of electrons, but that at lower temperatures there is a chemical reaction between the Pt and the Br_2. The work function for Pt in Br_2 is 1·4 V. The character of the emission in Cl_2 for a pressure of 0·028 mm. of Hg is described and shown to agree with the relation of the chemical properties of Br_2, I_2 and Cl_2. H. M. B.

2315. Electron Emission from Tungsten and Molybdenum Alloys. H. Freitag and F. Krüger. *Ann. d. Physik,* 21. 7. *pp.* 697–742, *Jan.*, 1935.—The thermionic constants (work function b_0 and the constant A) of Richardson's equation are measured for the purest W and Mo and for alloys of 10, 40, 60, and 90 % of W in Mo. A vacuum of 10^{-7} mm. of Hg or less is used, the apparatus thoroughly cleaned, and the measuring wire carefully shielded. The results in the final tube are quickly obtained, easily reproducible and reliable. For the pure metals they agree well with the best values of other experimenters. The b_0 value varies with the Mo content, falling rapidly to 10 % Mo and then rising linearly as percentage of Mo increases. The A values are calculated from the b_0 values and deviate from the theoretical $A = 60 \cdot 2$ amperes/(cm.^{2}grad.^{2}). For 60 % of Mo the experimental value of A agrees with the theoretical. Probably the b_0 value has a temperature coefficient. H. M. B.

2316. Influence of Oxygen Layer on the Valve Action of W, Ta and Nb. O. Mohr. *Zeits. f. Physik*, 93. 5–6. *pp*. 298–314, *Jan*. 19, 1935. —Using the double-frequency method, the influence of an oxygen layer on the valve action of W, Ta and Nb was determined from observations on change of capacity and hence of potential. The effect was much greater than that produced simply by age, thickness or temperature of the layer. The results are explained as being due to the extraordinary influence exerted by oxygen at the lattice points on the conductivity of the oxide, the latter occurring in active patches. A theory for the mechanism by which the layer changes in thickness is suggested and deviations of the experimental results from the theory are attributed to the effects of diffusion. F. C. C.

2317. Multiple Space Charge Effect. E. W. Thatcher. *Physics*, 6. *pp*. 81–85, *March*, 1935.—An investigation has been made of certain phenomena associated with space charge external to the grid which surrounds the kathode in a multi-grid valve. This paper reports a new effect, the essential feature of which is a negative plate current-emission characteristic. The conditions under which this phenomenon is observed are outlined. Results of experiments with double and triple grid valves are summarised. In general, two points on the characteristic may be found for which the plate current is independent of small variations in emission, whether of a statistical or "functional" nature. An explanation is presented based on the interaction of multiple space charge. An application to the problem of high-gain amplification is suggested. AUTHOR.

See also Abstracts 1889, 2296.

THERMOELECTRICITY.

2318. Thermoelectric Power and Resistance. L. Nordheim and C. J. Gorter. *Physica*, 2. *pp*. 383–390, *April*, 1935. *In German. English Abstract.*—Any perturbation introduced into a metal will give rise to an increased resistance and to a change in the thermoelectric power. Under certain circumstances a parallelism between these two changes may be expected. After a short review of the theoretical formulæ the cases of solid solutions, ferromagnetic substances and cold-worked and liquid metals are considered both from theoretical and experimental points of view. AUTHORS.

See also Abstracts 1967, 2228.